Electrical World

A McGRAW-HILL PUBLICATION

JANUARY 31, 1948

Features

NEWS OF THE WEEK
Philadelphia Meter Practice in Pictures
High-Reactance Transformers Limit Load Current
Supervisory Control Permits System Decentralization

Radio-Telephone . . . New Technique in Wire Stringing

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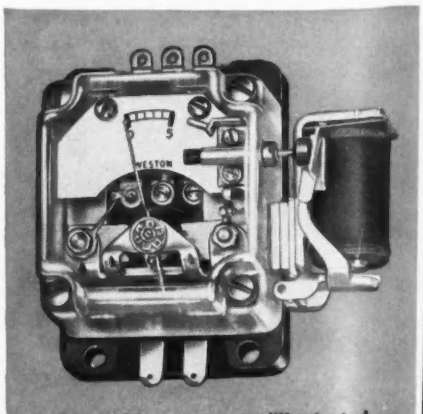

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January 31, 1948

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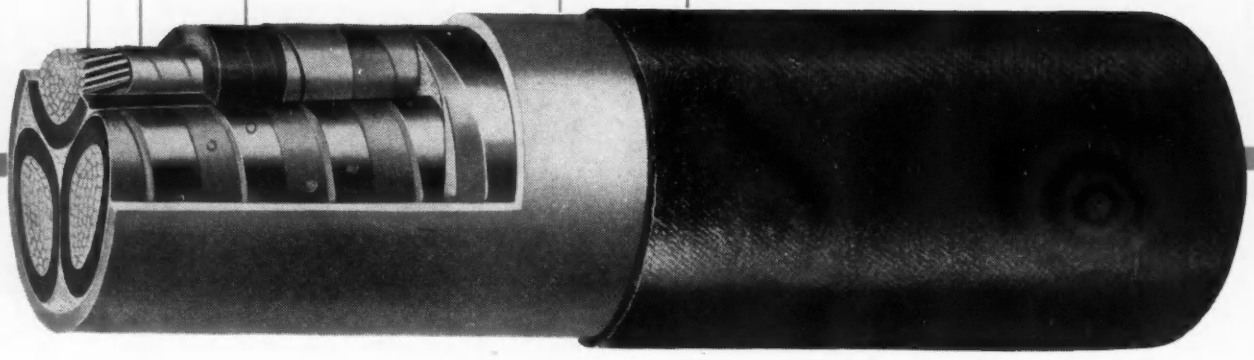

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Electrical World — Editorials

JANUARY 31, 1948

How To Change Power Policy

THE FATE of a major effort by the electric utility industry to rectify U. S. power policy probably will be decided next week. Decision is expected to come from another meeting between the Federal Power Commission and an industry committee. The topic is the Miller bills.

Last year, the Miller bills were subjects of long, unsuccessful hearing. The hearings broke up with a House subcommittee directing FPC to confer with industry and state commission representatives in an attempt to agree on suggested wording for mutally acceptable changes in the Act. Several such conferences already have been held. The latest, and quite possibly final one, is set for next week.

Perhaps of even more far-reaching consequence than the Miller bills is the industry—FPC relationship. For years, this has been bad—perhaps we should say non-existent. Of late, overtures for a more rational feeling have been made by each party. The move is a healthy one, to be sure. Each is engaged in serving the public, and each can do so better when its energies and talents are not expended in mutual frustration. No one who knows either group at all well will be concerned that the realignment might work against the public interest. Both groups include men who are entirely too individualistic and determined for that.

On the record, prospects for an amiable settlement of the dispute at next week's meeting seem not to be over-bright. There may be presumed to be certain areas of agreement. But they don't begin to cover the ground. It is not clear to what extent members of either negotiating group will be bitter-enders. Such a possibility isn't unreal.

Regardless of preconceptions either group may bring to the conference, some things remain clear. One is that FPC, at least, must report to the House group which set up the sessions. It must do so more or less soon. Its report will have to consist of the achievements at the time the report is made. Does this seem too apparent to mention? It is a major point, thoroughly understood by FPC, perhaps less surely grasped by industry conferees who do not have to report.

Another point is the industry's legislative prospect for 1948. It would be surprising if any responsible industry leaders really expect to put measurable policy changes into the statute books this year. The one opportunity to do so arises from the presumption that a settlement on the Miller bills can be negotiated with FPC. Congress would probably pass and the President probably sign Power Act amendments supported by FPC. It's hard to imagine the first and impossible to believe the second if the Commission opposes the legislation. If this summation be accurate, then the industry has a plain choice. It may take what it can negotiate this year, or go without and bet on 1949.

The industry has quite a legislative program. U. S. power policy needs a lot of revision. It can only be done in Congress. It would be a shame if the Miller bill conferences unnecessarily sour Congress on power policy revision—or on the electric utility business.

★ ★ NEWS OF THE

FPC Reverses Trend, Takes Step to Limit Own Authority

Joins NARUC in Proposing Amendments to Federal Power Act—Would Exempt Emergency and Non-Profit Exchanges of Energy in Interstate Transmission—More State Control

REVERSING A LONG-TIME TREND, the Federal Power Commission has taken a first step toward limiting its authority under the Federal Power Act.

The step is a short but significant one, as represented by a series of proposed amendments of the Act approved jointly by FPC and the National Association of Railroad and Utilities Commissioners. Principal effect of these proposals would be to:

1. Exempt from federal regulation all emergency, "slop-over" and non-profit exchanges of energy in interstate transmission.

2. Insure state regulation of electric utility operations wherever federal regulation under Part II of the Act does not apply.

3. Insure state regulation of local consumer rates from hydroelectric developments licensed by FPC under Part I.

Most important, of course, are the Part II amendments, which would set aside such extensions of FPC jurisdiction as approved by the courts in the Jersey Central and other cases. All the proposals will be submitted to the House subcommittee which instructed FPC to confer with both NARUC and utility industry spokesmen in an effort to present substitute language for the Miller bills.

They also will be discussed, it is presumed, at FPC's next—and probably final—meeting with industry spokesmen on Feb 5.

The proposed amendments suggest four changes in Section 201 of the Act, two in Section 20, and one in Section 19. The language of these changes, was accepted on Jan 12 by the Commission and NARUC's was rejected by FPC. This would have exempted from federal regulation "the transmission of energy by a person owning the same over the facilities of such person located wholly within one state for sale by such person within such state."

NARUC spokesmen insisted that they would carry this proposal to Congress, pointing out that it would resolve such issues as those posed by the recent Connecticut Light & Power case. Similar amendments of the Act have been urged previously by NARUC to afford exemption to wholly intrastate companies which receive interstate energy.

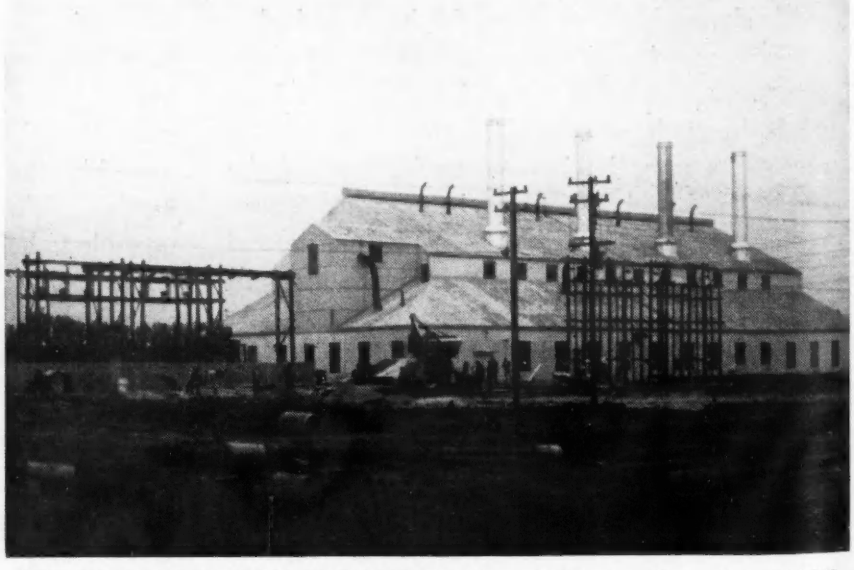
Actual language of the FPC-NARUC proposals would amend Section 201 to exempt from federal regulation "any transmission or sale of electric energy, which without payment therefor, slops over/or which meets "emergency needs" or "where settlement is made" at "out-of-pocket cost" or the "actual cost of purchase of such energy."

FPC and NARUC would clarify this proviso by further Section 201 amendments defining "emergency needs" and "slop over." The former would be defined as the "failure or inadequacy" of generating or transmission facilities caused by "breakdown, weather conditions, acts of God, or other unforeseen occurrences not reasonably within the power of the utility affected to prevent" and resulting in interruption or curtailment of service.

Energy would be deemed to "slop over" when it passed from one system to another "in consequence of a sudden increase or decrease in load" during "momentary" periods when such changes caused the two systems to be out of balance.

The final Section 201 amendment agreed upon by the state and federal bodies represents another long-sought gain for NARUC. It would provide for "public regulation" of electric utility operations by "state authority" where they are not subject to FPC jurisdiction under the Power Act.

The Part I amendments would change Section 20 to permit federal regulation of rates of hydro power only when the licensee also became subject to FPC jurisdiction as a public utility



THE LONGHORN ORDNANCE WORKS, Karnack, Tex., with its four 100,000 pounds-per-hour low pressure boilers, has been leased by the Southwestern Gas & Electric Co. Workmen in the foreground are pouring concrete foundations for the "used" 10,000 and 6,250-kw generators which will be installed

under Part II. A Section 19 amendment would reserve to FPC jurisdiction, as over hydro operations, where no state regulatory authority exists.

First industry reaction to the FPC-NARUC proposals was largely one of surprise. Unofficial reports on earlier conferences between the two groups indicated they had found little ground for agreement.

There was considerable speculation as to the reception of the proposed amendment by National Association of Electric Companies representatives and other industry spokesmen who have been conferring with FPC. This group may accept or reject all the FPC-NARUC amendments and still come up with additional amendatory proposals which could be reported to Congress. FPC, at the direction of the House subcommittee handling the Miller bills, must submit a report on all the conferences. It is expected that NARUC and, possibly, the industry will present additional views.

•

Davis Dam Won't Supply Power Everybody Wants

With Davis Dam construction work 20 percent completed, reports indicate power allocation applications already run far in excess of the capacity of the 225,000-kw Colorado River structure. A spirited state fight is shaping between California, Arizona and Nevada, and the Interior Department also has many applications from private utilities for firm requests for specific amounts of power.

More than $30,000,000 already has been spent or committed for the project and an additional $74,000,000 is needed for the fiscal years 1949-50 if the dam is to be completed on schedule by the end of 1950.

Originally panned at a 1942 cost of $41,000,000, revised figures indicate the final cost for the dam, power facilities, and transmission lines will be in excess of $104,173,635.

The new estimate takes into consideration a general revision of plans made necessary by the discovery of faults in the underlying rock which will require millions of dollars in additional excavation and grouting. There will also be other expenses.

ERP Demands Must Not Slow U.S. Power Expansion Plans

Tenney, Acting Editor of 'Electrical World,' Tells Senate Foreign Relations Committee of Heavy Demands on U. S. Manufacturers—Opposes Commitments Longer Than One Year

GREAT CARE should be taken lest demands of the European Recovery Program for electrical goods hinder the United States' power expansion program.

This was the burden of testimony presented this week (Jan 27) before the Senate Foreign Relations Committee by Acting Editor George C. Tenney of ELECTRICAL WORLD. Tenney, who appeared at the invitation of Sen Arthur Vandenberg, Michigan Republican and chairman of the committee, is also president of the McGraw-Hill Co of California, a vice-president of the McGraw-Hill Publishing Co and editor and publisher of Electrical West.

WILLIAM E. SCHUBERT, vice-president and general manager, Wisconsin Michigan Power Co, makes the first call over Michigan's first commercial power-line carrier. The new telephone system is a cooperative project with Michigan Bell Telephone Co "hitchhiking" messages over the utility's 2.4-kv circuit to serve rural areas

Tenney told the committee that the electrical industry is only "sparsely informed" as to the precise part it may be expected to play in whatever European Recovery Program may be adopted by the United States. In the absence of any real knowledge as to what may be required, Tenney went on, the problem of U. S. electrical manufacturers' participation can only be approached from the viewpoint of the demands that are now being made upon them.

It was made plain that existing demands on electrical equipment producers, plus those already scheduled for the next five years, will tax the productive capacity of the industry as long as it operates under present conditions. Any significant shipments to Europe of this equipment, particularly in the next two or three years, would have to be taken from U. S. power systems, Tenney said. He emphasized that this equipment is needed badly—and as soon as possible—by domestic power suppliers. Almost none of it, Tenney went on, will go to restoration of reserve requirements before 1950.

Tenney closed his statement with an "urgent" request that neither U. S. electrical manufacturers nor power systems be tied to any commitment extending for longer than one year in advance.

Senator Vandenberg, commenting on Tenney's concern about the vagueness of the program as it affects the electrical industry, pointed out that the ERP at present is "necessarily fluid." He added that almost no technical information is available thus far and emphasized that no commitments have been made. The whole program, he said, will depend primarily upon the decisions of its administrator when he is appointed.

Vandenberg added that it is "obvious" that the electrical industry wants

DEDICATION of second 65,000-kw unit at the R. E. Burger Plant of Ohio Public Service Co at Dilles Bottom brought together C. S. Bowden, left, production manager; E. N. Pringle, plant production superintendent; G. E. Snider, vice-president in charge of operations; President R. E. Burger; G. L. Hadden, superintendent of construction; G. W. Saathoff, New York consulting engineer and designer of the plant; and H. L. O'Brien, first vice-president, Cities Service Co

neither definite requests nor commitments for materials at this time.

Tenney presented portions of a study by Ebasco Services, Inc, showing that the delivery promises for 8 of 12 selected power equipment items had lengthened, last Dec 31, from the promises of Dec 31, 1946. Only for poles, motors, boilers and distribution transformers had delivery promises improved during 1947, the study showed.

The study also showed the following estimates for the time between placing the order and putting into operation of several types of plant:

Steam-electric stations, 30,000 kw and over—42 months; substations, 10,000 kw and over—33 months; transmission lines—30 months; hydroelectric stations, 27 months.

•

Utility Adding Units

Delaware Power & Light Co has announced a construction program to cost an estimated $16,991,493. The largest item is the addition of a 30,000-kw unit with boiler and auxiliary facilities at the Vienna, Md., plant of the utility. Cost of these improvements will be $5,450,000. Two 15,000-kw units are now under construction at the plant. The rest of the program will consist of adding to the system transmission and distribution facilities.

•

140,000-Kw Texas Plant

Southwestern Gas & Electric Co will begin work immediately on a 140,000-kw plant on a site seven miles southeast of Longview, Tex. When fully developed the plant will have four 35,000-kw generators. Natural gas will be used for fuel. The plant will be erected on the banks of the artificial Lake Cherokee.

REA Accused of Political Finagling by Ex-Employee

Rural Electrification Administration will answer charges of "political finagling" and "incompetent" staff work before a Senate subcommittee Feb 5. Indictment of the lending agency, hurled at it by a former REA employee and electric cooperative official, developed during otherwise routine hearings last week. The charges came to light when a letter from Claude W. Eppard of Luverne, Minn., was read into the record.

Eppard, one-time employee of REA's engineering division and later an officer of the Dairyland Power Cooperative of LaCrosse, Wis., immediately was summoned to appear before the subcommittee. Present officers of the Dairyland co-op, REA officials, and perhaps representatives of other co-ops also are expected to testify at the Feb 5 session.

Eppard's letter was addressed to Sen. William Langer, chairman of the Civil Service Committee, and to Reps H. Carl Anderson, August Andresen, Harold Knutson, and John Taber. It charged that farmers served by REA-financed electric systems are "victims of high costs, poor engineering design, and poor service, resulting chiefly from political finagling" by the lending agency.

Eppard also deplored what he termed "the dangerous degree of control being exercised by REA" over borrower cooperatives. This control, he asserted, is more stringent than that "the old utility holding companies generally held over their operating companies." On the other hand, he added, REA cannot offer the "expert administrative and engineering service" which was furnished by the holding companies. REA does get some "qualified engineers," he conceded, but of few of them "remain long" with the agency.

REA keeps the co-ops in line by writing restrictions into its loan contracts, Eppard said. He cited provisions of an REA loan contract with Dairyland, which require the co-op to hire legal services and consulting engineers approved by the agency. Co-op managers also must be okayed by REA, Eppard stated, and some loan contracts permit the removal of "any employee" of the co-op by the REA administrator.

•

Sale of Surplus Oklahoma Power Plant Up to WAA

War Assets Administration attorneys still are juggling one of their hottest political potatoes—the disposal of the steam generating plant at the Oklahoma Ordnance Works, near Chouteau, Okla.

The facility, for which Oklahoma's Grand River Dam Authority and the Public Service Co of Oklahoma are the principal competitors, was dropped back in WAA's lap by a Congressional subcommittee last week.

The subcommittee, after extensive hearings, directed the agency to determine whether Grand River qualified as a priority bidder under the Surplus Property Act. If so, the Congressional group concluded, it should sell the plant to the state agency; if not, the property should be reoffered for sale.

Grand River Dam Authority bid $3,500,000, the exact amount fixed by WAA as the fair value of the steam plant. Public Service Co originally offered $2,535,500 but later sought to raise its bid to $3,600,000.

The subcommittee further advised WAA to determine whether sale of the facility to Grand River would serve "the public interest" and fill the authority's legitimate needs," as required by the Surplus Property Act.

Fishing Association Wants No More Dams in Northwest

Claims Utilities Can Get All Energy Needed by Expanding Plants at Present Sites—Power Officials Disagree and Say Low Water Storage at Peak Demands Would Cut Capability

POWER NEEDS of the Pacific Northwest, as outlined by utilities in the area, can be met before 1956 by the installation of additional generators in plants already built and under construction, the Columbia River Salmon and Tuna Packers Association maintains.

In a statement issued by the Association at Astoria, Ore., it is explained that the fish industry is vitally interested in the power program. The building of more high dams in the Columbia and Snake Rivers will have a far-reaching effect on the salmon runs in those streams.

Pointing out that a recent conference of utilities estimated that 1,967,000 kw additional would be required by 1956 to meet demands, the packers listed projects which they claim would more than meet this figure.

The utilities report indicated that a new generator at Pacific Power & Light's Ariel Dam on the Lewis River would provide 45,000 kw and Seattle City Light's Gorge Dam Plant 60,000 kw and Ross Dam 360,000.

Possible Unit Locations Listed

To these, the association lists the following units as now being installed or where existing plant space is available:

Kerr Dam of the Montana Power Co, 56,000 kw in the fall of 1948; Alder Dam near Tacoma, 25,000 kw available this year; Idaho Power Co, 185,000 kw by 1950; Grand Coulee, 11 more units, increasing capacity by 1,430,000 kw; Hungry Horse Dam in Montana, 286,000 kw by 1955; Rock Island Dam, near Wenatchee, Wash., 160,000 kw.

All these listed additional facilities would add 2,607,000 kw to Northwest power production, more than enough to meet demands estimated by the utilities.

Utility representatives, however, dispute the accuracy of the packers' figure on Grand Coulee, explaining that five of the 11 units yet to be installed were not included in the utility's compilation. Thus the packers' estimates would be reduced by about 600,000 kw. Also, it was pointed out, the last six units at Grand Coulee will not be full-time producers because of insufficient water supply.

During the Columbia's peak spring flow there will be sufficient water to operate all units and the new units will be used to pump water for irrigation. They will be of little or no value in meeting December and January power demands, when additional power is most needed.

In voicing their objection to more dams because of their effect on salmon runs, the packers said, "we fully agree with the utilities conference that new generating facilities are needed, but we still contend that new generating facilities should be added to existing plants before new dams are authorized and built."

A statement released by the Pacific Northwest Utilities conference said that power requirements in the region exceed the safe operating capacity of generating facilities and are increasing at a rate beyond any federal construction schedule.

Bonneville Sets Record

Bonneville Dam power plant set a new record in 1947 by generating 4,073,955,000 kwhr of energy. The previous record year was 1944 when 3,589,355,000 kwhr were produced. Load factor for 1947 was 81.59 percent. The plant capacity factor was 91.84 percent.

Seattle Contractors Face Anti-Trust Act Charges

The Seattle Electrical Contractors Association and 11 of its members have been indicted by a federal grand jury at Seattle, Wash, on a charge of "arbitrarily" setting electrical installation prices in that area since 1936, and "engaging in a combination and conspiracy in restraint of trade among several states in violation of the Sherman Anti-Trust Act."

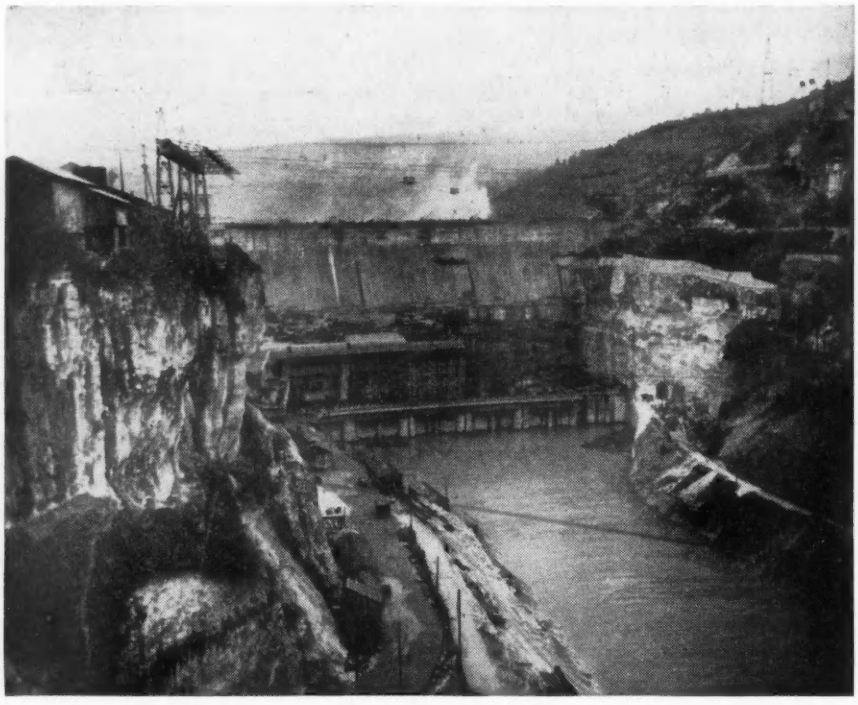
The indicted concerns are declared to handle more than $5,500,000 worth of business annually, representing 75 percent of the electrical installation business in the Seattle area.

Charged in the indictment, in addition to the Association, were R. D. Horning, manager of the group; Van S. McKenny Co and its president, Van S. McKenny; O. A. Carlson Co; Northwest Electrical Co and its president, L. J. Benedetti; Puget Sound Electric Co and its president, Kalman Brauner; City Electric & Fixture Co and its president, G. C. Burke; L. A. Gattavara, president of the Association; F. T. Holert, owner of Holert's Electrical Service; W. Watts, owners of Watts Electric & Appliance Co; C. S. Greene, partner in the Agutter Electric Co; R. B. Lane, trustee of the association; C. F. Meagher, owner of Mars Electric Co, and R. A. Montgomery, who operates the Montgomery Electric Co of Seattle from Portland, Ore.

Each of the concerns and individuals charged is liable to a maximum fine of $5,000 and/or a year in jail, if found guilty.

The complaint charges the indicted concerns with operating a bid depository in order to keep prices in line

OFFICERS of the Electric Institute of Boston at the Institute's annual dinner meeting on Jan 22. James A. Galvin, left, Boston Edison Co, assistant secretary; Ralph DeLoid, Westinghouse Electric Supply, treasurer; William H. Kaiser, General Electric Supply, president; and Thomas H. Carens, Boston Edison, vice-president. Missing is William F. Ofgantz, Rochester, Mass., secretary



SECOND LARGEST DAM in Europe, France's Genissiat Dam in the southeastern section of the country, began producing electricity on Jan 19 when its first 70,000-kw unit went into operation. Three more units of the same size will follow. Europe's largest dam is the Russian dam at Dniepropetrovsk

and eliminating competition among themselves and with using a uniform method of calculating basic job costs. It is part of a nation-wide investigation on restraints of trade in the housing and building field.

•

St. Lawrence Power Plan Up for Debate in Senate

Senate debate on the St. Lawrence Seaway and Power project opened this week (Jan 26) amidst rumors of a possible filibuster.

Sen Alexander Wiley opened discussion of a resolution authorizing construction of the project by urging its passage. But Sen Henry Cabot Lodge, Jr, scheduled to speak on the resolution Wednesday, and others asserted they would make "long, long speeches."

Strategy of the opposition apparently is to delay a vote on the measure until the Senate decides to shelve it in favor of more pressing business. The Senate leadership already has announced that it hopes to begin discussion of the European relief program early in February.

Sens Saltonstall, Connally, George, and Overton are also expected to make speeches opposing the resolution. Senator Lodge, chosen to lead the floor fight against the project, discounted reports that a filibuster would develop but warned that the opposition speeches would be "lengthy."

Energy Sales Increased 11.6 Percent in October

Sales of electric energy to ultimate customers in Oct 1947 totaled 18,655,776,000 kwhr, compared with 16,721,294,000 kwhr, in Oct 1946 an increase of 11.6 percent, the Edison Electric Institute reports.

Revenues from ultimate customers amounted to $328,208,600, compared with $292,697,200 in Oct 1946, an increase of 12.1 percent.

For the 12 months ended Oct 31, 1947, the average use per customer advanced to 1,418 kwhr from 1,312 kwhr for the preceding year, an increase of 8.1 percent; the average annual bill to $44.10 from $42.64, an increase of 3.4 percent; revenue per kwhr dropped to 3.11 cents from 3.25 cents, a decrease of 4.3 percent.

Classification of Sales, October, 1947

Kilowatthour sales October	Million Kwhr 1947	1946	% Change
Residential or domestic.....	3,601	3,130	+15.1
Rural (Distinct rural rates).	498	410	+21.4
Commercial or industrial			
Small light & power.....	3,293	2,821	+16.7
Large light & power.....	9,951	9,064	+ 9.8
Street & highway lighting...	219	206	+ 6.2
Other public authorities.....	499	471	+ 6.0
Railways & railroads			
Streets & Interurban.....	338	351	— 3.7
Electrified steam railroads.	210	221	— 5.0
Interdepartmental	46	47	— 1.8
Total to ult. customers....	18,656	16,721	+11.6

House Passes Rockwell Bill with One Amendment

The Bureau of Reclamation, long a Congressional favorite, took a significant reversal last week (Jan 22) when the House rewrote and passed its own version of the Rockwell Bill. Two major provisions sought by the Bureau were lost in the final 220-134 vote on the measure.

First of these was a requirement contained in the original bill but long since abandoned in committee. It permits authorization of new Reclamation projects only by act of Congress. The House also set the pay-out period for projects at 50 years, instead of 78 as proposed by the Bureau.

Unchanged was a proviso for reduction of interest on project power investment from 3 to 2½ percent, with 2 percent earmarked for payment into the Treasury and the remainder available for application to amortization of irrigation expenditures.

The Rockwell Bill was introduced early last year after House Appropriations Committeemen and others demanded revision of amortization features of the Reclamation laws. The measure was bottled up in committee most of the year, with the Reclamation Bureau offering revision after revision. As finally reported by the Committee, it was approved by the Bureau as an acceptable "compromise."

Another section requested by the Bureau was accepted by the House. It permits the allocation of a portion of project costs to fish and wildlife preservation works, recreational facilities, and salinity and silt control activities. These costs will not be repayable.

House debate on the bill continued for three days, with the proponents of the Committee version voting down all amendments during the first two. However, on the final day, the opposition, led by Representatives Jensen of Iowa and Elliott of California, rallied sufficient votes to win approval of the amendments introduced by the former.

A similar bill was introduced in the Senate last year by Sen Hugh Butler. It was assigned to the Public Lands Committee, which has been awaiting House action on the Rockwell Bill.

•

Municipal Plant Down

The Celina, Ohio, municipal power plant has been shut down since Jan 18 because of boiler trouble. A standby plant and power purchased from the Dayton Power & Light Co are providing electricity needed. It will take a month to get the boiler back in service.

Arizona Utilities Will Get Ample Natural Gas Supply

Expansion of El Paso Gas Co Will Allow Companies to Back Hydro Capacity with Steam Generation

A one-cent reduction in natural gas rates to industrial users in Arizona and a $15,000,000 construction program to make available 14,000,000 cu ft of gas annually for use for electrical power generation has been announced by the El Paso Natural Gas Co.

The power produced from the new source of energy by the state's utility companies will, to a great extent, relieve Arizona's critical shortage of electricity resulting from drought curtailment of hydroelectric production.

As announced by Paul Kaiser, president of El Paso Gas, the rate reduction will be retroactive to Jan 6. Companies benefiting from the cutback are the Salt River Valley Water Users' Association, Central Arizona Light & Power Co, Tucson Gas, Electric Light & Power Co, and the Arizona Edison Co.

The reduction is from 19 to 18 cents per 1,000 cu ft. The reduced rate, however, will not result in cheaper rates to residential consumers of gas or gas-generated electricity. Utilities officials maintain that higher production costs in every department will prevent consumer reductions.

By mid-February the El Paso company will start construction of new gas lines from its New Mexico fields. An 8-in. line will connect the Phoenix area with the company's 26-in. line which will pass within 20 miles of the city.

The rate reduction, coupled with the guarantee of firm power, probably will permit the utilities to abandon use of fuel oil for generating purposes. The high cost of fuel-oil generation had threatened to necessitate asking rate increases in the state.

Central Arizona L&P, which had always used gas when it was available, has had an arrangement with the gas company which held it to a refund for oil used to supplement gas.

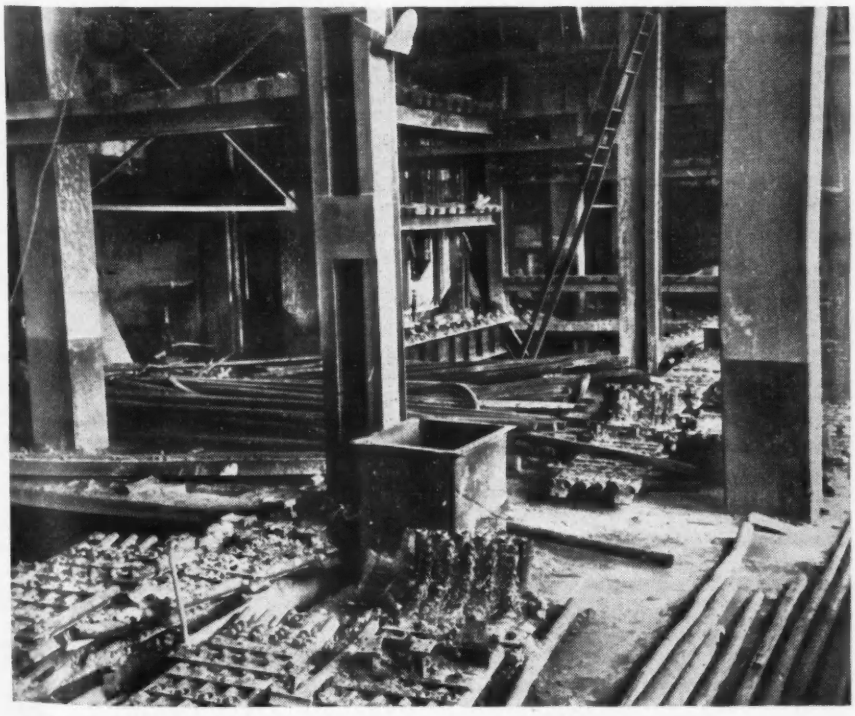
The Water Users' Association, formerly an infrequent user of gas, paid 26 cents per 1,000 cu ft for the fuel when it was available.

The savings for this group are estimated at more than $1,900,000 yearly under the plan. This group uses hydroelectric power for only 40 percent of its generation.

•

Voted 2 Franchises

Missouri Edison Co has been voted 10-year franchises in Elsberry and Bowling Green. Twenty-year franchises in both cities expired in the spring of 1946. Bowling Green voters in July, 1946, approved a bond issue to construct a municipal power plant and distribution system. The bonds were never sold as it was found that the amount of the bond issue was insufficient to provide construction funds.



THIS POWER PLANT at Fushun, 30 miles from Mukden, Manchuria, isn't of much use to anyone since the Russians shipped the machinery to their homeland

California to Send Power to Nevada, Papers Report

A report that the Pacific Gas & Electric Co has signed a contract with the Sierra Pacific Power Co to deliver 70,000 kw of energy to the Nevada border beginning late in 1949 has been reported by Nevada newspapers. PG&E officials admit that they have made the offer but have refused to confirm signing of the contract.

PG&E now is delivering about 30,000 kw, 73,000,000 kwhr annually, over two 60 kv lines, and delivery on the recently negotiated contract depends on construction of a new 110 kv line. PG&E will construct for about $538,000 its section of the line from its Drumm plant west to Donner Summit and Sierra Pacific will complete the project with a line to a projected substation near Reno. The total outlay on the part of the Nevada utility will be $700,000.

Sierra Pacific now purchases about 60 percent of its power from PG&E at a price believed to be about 8 mills. Under terms of the new 15-year contract the rate will be cheaper. The existing contract, effective until 1952, will be replaced by the new.

The new transmission line probably will follow a different route through the mountains than the present lines, thus reducing the chances of power failure caused by storms. A survey will get under way next summer.

It is estimated that Sierra Pacific will need 148,000,000 kwhr by 1952 and 267,000,000 kwhr by 1960.

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Canadian Output Statistics

The Dominion Bureau of Statistics has released the following statistics of Canadian central electric stations in thousands of kilowatt hours:

Period	1947	1946
Eleven months	41,321,806	37,931,592
Primary	35,322,533	29,463,980
Secondary	5,999,273	8,467,612
Exports to U. S.	1,980,016	2,306,263
November	3,613,726	3,566,742
Primary	3,330,741	2,888,902
Secondary	282,985	677,840
Exports to U. S.	137,630	140,005
October	3,862,696	3,550,001
Primary	3,406,198	2,844,171
Secondary	456,498	705,830
Exports to U. S.	147,164	183,108

•

Indians Win First Step

The Nez Perce and Yakima Indians have won the first round of their fight to secure an injunction to stop construction of the McNary Dam. Federal Judge Sam M. Driver at Spokane refused to dismiss their suit and urged a quick trial.

Commonwealth Edison Co Submits Franchise Plan

CHICAGO—A new franchise containing rate adjustment provisions and an increased franchise tax would be acceptable to the Commonwealth Edison Co, its attorney indicated last week.

But, the Commonwealth spokesman insisted, the company has not been exacting excess charges since 1946. Contentions that it has done so are based on improper data, improperly used, according to F. X. Busch, Commonwealth's counsel. Busch's comments were sent to Alderman C. P. Wagner, head of Chicago Council's Public Utilities Committee.

Busch said the allegation of excess revenues since 1946 amounting to $12,485,000 of which almost $11,000,000 was derived from residential and commercial customers, came from an unjustifiably low rate base and the application to it of a rate of return which was ruinously low.

Earlier, Alderman Wagner had recommended committee approval of a "take it or leave it" franchise offer. It included:

1. A 43-year franchise terminable on one year's notice.
2. An annual automatic rate adjustment clause governed by operating expenses.
3. An annual franchise tax of 5 percent. Present tax is 3 percent of gross receipts.

Busch, in reply, proposed a new rate adjustment formula which he said adheres to the city's wishes but removes the rigidity of the city's provisions to which Commonwealth objected.

Guessing around City Hall was that Busch's reply not only clarifies several issues but will hasten final action. Presently, the franchise negotiations are well ahead of the timetable foreseen last fall when dealings began.

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Iowa Renews Fight to Bar Co-op Projection Cedar R

The state of Iowa last week (Jan 23) renewed its fight to prevent construction by a cooperative of a hydroelectric project on the Cedar River.

In an application to the Federal Power Commission, the state requested a rehearing of proceedings which ended last December (EW, Jan 3, Page 26) when the Commission granted First Iowa Hydro Electric Cooperative a license for the Cedar River project. Thus the way was opened for a further court test of the case.

Iowa's petition contends that the Cedar is not a navigable stream within the concept of the Federal Power Act and therefore is not subject to federal jurisdiction. It also holds that FPC has not complied with the act in granting the first hydro license over state protests, that the project is not economically feasible, that First Iowa has failed to prove its ability to finance the development, and that construction in accordance with the co-op's plans would impair navigation and commerce elsewhere on the river.

The state previously carried the case to the Supreme Court on its objection that the co-op had failed to comply with Iowa laws. The court remanded the case to FPC on the ground that, if the Cedar were a navigable stream, federal jurisdiction would supersede that of the state. FPC found the stream to be navigable and granted the license despite the intervention of the state.

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Raising Plant Capacity

Southwestern Public Service Co will increase the capacity of its East Plant at Amarillo to 77,500 kw. The plant now has a capacity of 40,000 kw. The steam turbine is to be delivered in 1951. Cost of the building addition and plant equipment will be $5,000,000.

Utility Operating Revenues Rose 12.8% in November

Electric operating revenues of the larger privately-owned electric utilities in the United States in Nov 1947 totaled $323,064,000, compared with $286,414,000 in Nov 1946, an increase of 12.8 percent, the Federal Power Commission has reported.

Revenue deductions (including operating expenses, depreciation and taxes) amounted to $257,149,000 or 15.2 percent over those of Nov 1946.

Gross income, including other utility operating income, totaled $71,056,000, a decrease of 5.6 percent for the month. Net income for the month was down 7.6 percent to $51,277,000 from the $55,487,000 reported for Nov 1946.

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PUD to Acquire Utility

Acquisition of power properties at Chelan, Wash., by the Chelan Public Utility District moved forward recently when the Chelan County Superior Court overruled a demurrer action by the Washington Water Power Co. As a result of the action, the PUD will be able to obtain a certificate of necessity to acquire the property.

MEETINGS

Southeastern Electric Exchange—Accounting Conference, Henry Grady Hotel, Atlanta, April 1-2; Annual Meeting, Boca Raton, Fla., April 8-10; Spring Conference, Engineering and Operating Section, Tampa Terrace Hotel, Tampa, Fla., May 6-7. John W. Talley, executive secretary, 303 Haas-Howell Building, Atlanta, Ga.

Edison Electric Institute—Annual Sales Conference, Edgewater Beach Hotel, Chicago, April 6-8; Annual Convention, Hotel Traymore, Atlantic City, June 1-3. H. S. Bennion, managing director, 420 Lexington Ave., New York 17, N. Y.

Electrochemical Society—Spring Congress, Deshler-Wallick Hotel, Columbus, Ohio, April 14-17. R. M. Burns, secretary, 235 West 102nd St., New York 25, N. Y.

Northwest Electric Light & Power Association—Engineering and Operation Section, Davenport Hotel, Spokane, April 14-16; Accounting and Business Practice Section, Davenport Hotel, Spokane, April 17-18; Annual Business Meeting, Empress Hotel, Victoria, B. C., May 10; Business Development Section, Empress Hotel, Victoria, B. C., May 10-12. Berkeley Snow, secretary, 802 Spalding Building, Portland 4, Ore.

Missouri Association of Public Utilities—Annual Convention, Hotel Jefferson, St. Louis, April 28-30. William H. Allen, general counsel, 101 West High St, Jefferson City, Mo.

PREVIOUSLY LISTED

Pennsylvania Electric Association—Communications Committee, Benjamin Franklin Hotel, Philadelphia, February 5-6; Prime Movers Committee, Hotel Alexander, Hagerstown, Md., February 19-20; Electrical Equipment Committee, Castleton Hotel, New Castle, Pa., February 19-20; Systems Operation Committee, Abraham Lincoln Hotel, Reading, Pa., February 19-20; Transmission and Distribution Committee, Castleton Hotel, New Castle, Pa., February 26-27.

Missouri Valley Electric Association—Power Sales Conference, President Hotel, Kansas City, Mo., February 5-6.

Edison Electric Institute—Transmission and Distribution Committee, New Jefferson Hotel, St. Louis, February 9-10; Prime Movers Committee, Edgewater Beach Hotel, Chicago, February 9-10; Meter and Service Committee, Joint Meeting with the AEIC Committee on Metering and Service Methods, Biltmore Hotel, Oklahoma City, Okla., February 9-11; Electrical Equipment Committee, Netherland Plaza Hotel, Cincinnati, February 12-13; Accident Prevention Committee, Roosevelt Hotel, Pittsburgh, February 16-17.

National Adequate Wiring Bureau—Annual Conference, Stevens Hotel, Chicago, February 22-26.

American Society of Mechanical Engineers—Spring Meeting, St. Charles Hotel, New Orleans, March 1-4.

Oklahoma Utilities Association—Annual Convention, Biltmore Hotel, Oklahoma City, Okla., March 11-12.

National Electrical Manufacturers Association—Winter Convention, Edgewater Beach Hotel, Chicago, March 14-18.

Canadian Electrical Association—Western Conference, Palliser Hotel, Calgary, March 15-17.

Institute of Radio Engineers—Annual Convention, Hotel Commodore, and Radio Engineering Show, Grand Central Palace, New York, March 22-25.

American Institute of Electrical Engineers—Conference on Electron Tubes for Instrumentation and Industrial Use, sponsored by the Joint Subcommittee on Electronic Instruments, Benjamin Franklin Hotel, Philadelphia, March 29-31.

National Association of Corrosion Engineers—Annual Conference and Exhibition, Jefferson Hotel, St. Louis, April 5-8.

Midwest Power Conference—Sheraton Hotel, Chicago, April 7-9.

New Product Introduced to Reduce Reflected Glare

Coming now into some commercial development is a light-transmitting sheet that is claimed to eliminate reflected glare. The sheet consists of multiple layers of thin transparent plastic, sandwiched between plates of glass or plastic. Light rays, passing through the sandwich, undergo multiple reflections and refractions. The result, according to the inventor, Alvin M. Marks, is "radial polarization" of the light.

Whatever the phenomenon is termed, there is no doubt that a significant reduction of reflected glare results from it. Colors under the "Radially polarized" light appear to have more body, and objects are more clearly defined, than under ordinary light. Visual discrimination is improved. A feature of the sheet is that it provides a horizontal direct light cutoff, usually obtained by enclosures or louvers. The cut off is about 20 deg.

The assembly of plastic layers in its finished form has been named "Polaply." It has a light transmission efficiency of 50 percent. With properly arranged reflector surfaces, the effective transmission is stated to approximate 70 percent of the output from the light source. Thus for equal intensity about 40 percent more output is required from the light source than for usual lighting. However, the increased contrast ratio, making for improved visibility and color perception under "Polaply," quite effectively compensates for the reduction in intensity.

Recent experiments and developments indicate that "Polaply" can be applied in "snap-on" units to desk and other portable lamps, as a built-in element of fixtures, and as an overall ceiling with light sources above. The product is being introduced commercially by Polarized Illumination, Inc, Whitestone, Long Island, N. Y., holder of licenses under the Marks patents.

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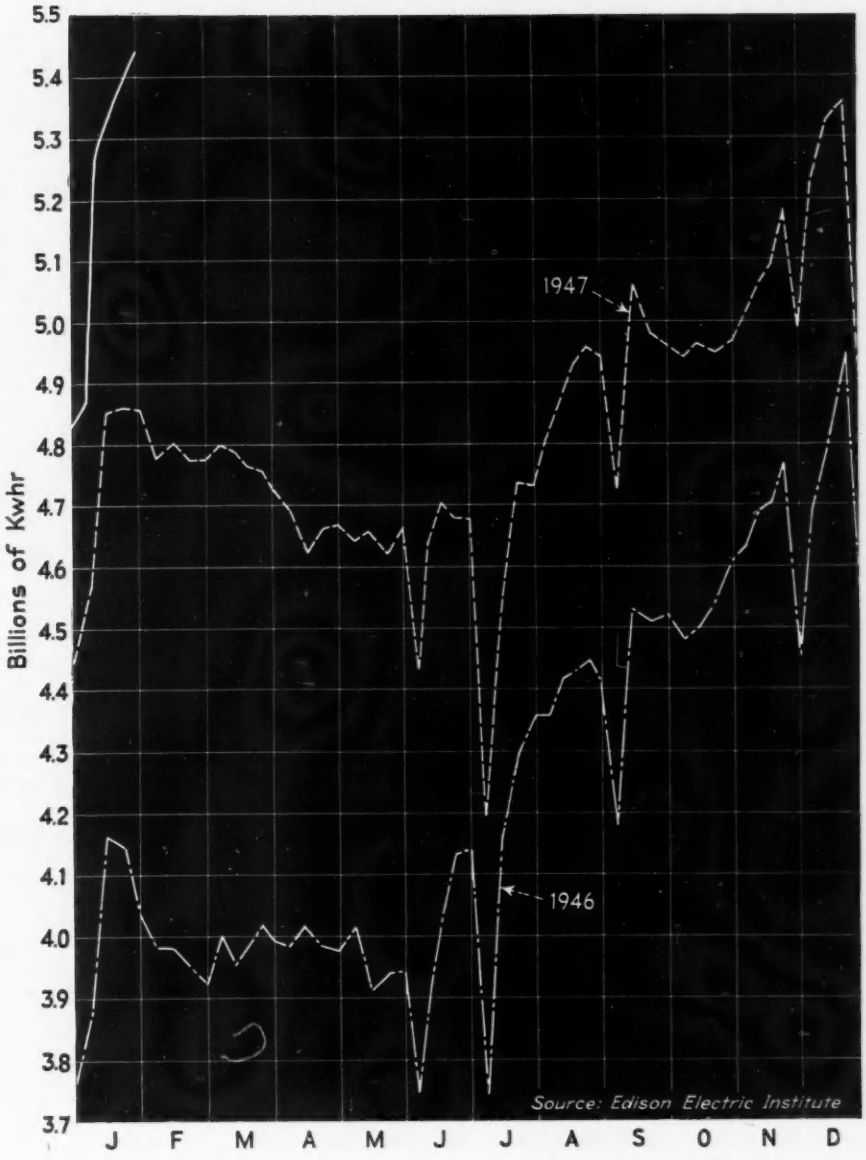
Power Shortage Strikes Abitibi Region of Quebec

The worst power shortage in 25 years has struck the Abitibi region of Quebec. The LaSarre Power Co, which supplies the region, now is rationing power to a maximum of 30 minutes each two hours throughout the 24-hour day. Towns affected are LaSarre, Normetal, Amos, Taschereau, Macamic, and Dupuis.

An official of the power company said Lake Macamic, source of power supply for the company, is almost dry.



Electric Output Sets New High Record

Again swinging upward, the electric output curve set a new high record during the week ended Jan 24, 1948, according figures released by the Edison Electric Institute.

The amount of electric energy distributed totaled 5,436,430,000 kwhr, comparing with 5,370,112,000 kwhr during the preceding week. The amount of electrical energy distributed during the corresponding week of 1947, that ending on Jan 25, amounted to 4,856,404,000 kwhr, this year's figure representing an increase of 11.9 percent. The overall change for the preceding week was an increase of only 10.6 percent.

Weekly Output, Millions Kwhr

1948		1947		1946	
Jan. 24	5,436	Jan. 25	4,856	Jan. 26	4,034
Jan. 17	5,370	Jan. 18	4,857	Jan. 19	4,145
Jan. 10	5,278	Jan. 11	4,853	Jan. 12	4,163
Jan. 3	4,868	Jan. 4	4,574	Jan. 5	3,865
1947		**1946**		**1945**	
Dec. 27	4,830	Dec. 28	4,442	Dec. 29	3,759
Dec. 20	5,368	Dec. 21	4,940	Dec. 22	4,239
Dec. 13	5,327	Dec. 14	4,778	Dec. 15	4,154
Dec. 6	5,218	Dec. 7	4,673	Dec. 8	4,097

Percent Change from Previous Year

	Jan. 24	Jan. 17	Jan. 10
New England	+11.7	+11.7	+ 9.2
Mid-Atlantic	+ 9.4	+ 7.8	+ 4.9
Central Industrial	+11.5	+11.8	+10.0
West Central	+13.1	+11.1	+13.9
Southern States	+13.6	+12.3	+ 9.5
Rocky Mountain	+10.3	+ 8.7	+ 7.5
Pacific Coast	+13.4	+ 8.7	+ 8.3
Total United States.	+11.9	+10.6	+ 8.8

Other News

New Equipment	Page	86
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Construction		105

Electrical World

OPINION

Stating the Problem

ALMOST A YEAR AGO, New York State's Public Service Commission undertook, on legislative order, an investigation of gas shortages which then troubled domestic and industrial consumers. Its report was released recently. While concerned primarily with gas, the recommendations also covered electricity. The report coming as it did, when metropolitan electric systems were struggling to restore service after a disastrous ice storm, seemed at first glimpse to be an indictment of those power systems. Actually, it was nothing of the kind.

There are numerous significant passages in the report. One of them, though addressed to gas problems, bears so closely on electricity supply problems as to merit repetition. Said the NYPSC:

"A very important fact regarding the expansion of facilities to meet demands...has escaped full attention... Cost of constructing additional generating, transmission and distribution facilities is now very much greater than it has been for a whole generation. Utilities are required to make those expenditures...to comply with the statutory requirement...As the inevitable result, the cost... will be heavy and consumers must be prepared to pay not only the increased costs but also depreciation, taxes and a fair return upon the investment which the utilities are virtually compelled to make. In unregulated, competitive business a producer may refuse to expand...The public utility has no option; it has a public duty to provide adequate service."

It is difficult to imagine a more accurate statement of the problem which now faces the entire utility industry. Solution of the problems of capacity restoration and its financing will be simplified no end if all regulatory bodies recognize and live by such a statement.

Trees, Ice, Service

LITERALLY NOTHING—unless it be Joyce Kilmer's poem—can be as majestic as a tree. Mankind has always marvelled at Nature's handiwork and revered the beauty it lends to the landscape, singly or in groups. Quite rightfully then, cities and citizens are jealous of their trees. Those that have few arbored archways over their streets are excusably envious of those that have them. In fact, it is often just short of brutal to cut down a shapely and flourishing tree, and just short of criminal to cut out limbs or branches in such a way as to mar the stately lines of the tree.

Of course, it is not generally necessary to cut down a tree nor even prune it in such a way as to ruin its contour just to provide a path for power wires through the branches. Foresters privately engaged by citizens to nurture and preserve their trees are the same ones retained by the power companies to do public pruning in concert with municipal foresters and tree wardens. It does not make sense that they should be considerate with their right hands and inconsiderate with their left hands.

All this has a definite bearing on the ice storm which tore down many wires in the hinterland of New York City. Some 400,000 customers were without electric service for more or less sustained periods. As usual in such widespread disruptions, the hue and cry goes up for putting the wires underground—everywhere—regardless. Politicians and agitators seem not to realize that it was the cherished trees that brought the wires down. Statistics will show that the great majority of the wire breaks occurred at spots where branches of ice-laden trees bowed and added their own burden to that already borne by the ice-laden wires.

Putting all wires underground would admittedly escape the hazards of ice and wind. It also would skyrocket the costs of bringing service to outlying areas. What the Johnny-on-the-spot agitators fail to realize is that every property owner would face a corresponding outlay to put underground the service wires from the curb to the cellar wall. Candor on these points should lead to a sane decision to render the trees much less a hazard to electric service without detracting one iota from their natural beauty. A little more explanation by the power companies and a little more rationality and tolerance on the part of the public ought to pave the way for judicious tree-pruning and less wholesale outage when the next ice storm strikes.

Sixty-cycle Curricula

POWER COMPANIES are beginning to be concerned about their technical manpower. They show signs of engaging in active recruiting to offset the disparity of older men in their ranks. There will be little return, however, for their efforts unless there are schools minded, mooded and physically equipped to turn out the desired product. Students will not manifest adequate interest in the power field unless these favorable influences exist.

Next step in the process is, then, to explore the educational field. The search should be designed to elicit the facts, particularly with reference to the assertion that most faculties, as a result of the wartime demand for

electronics, barged off strongly in that direction. Have or have not most of them returned to their former proportions of orthodox 60-cycle "power" courses and of the newer kilo- and megacycle "electronics" courses?

With those facts available, the utilities will know where they would be accorded a sympathetic reception in their hunt for 60-cycle power system cadets. They will know also where they should expect to find graduates well-versed in the fundamentals underlying two-way radio, carrier and wire communication, electronic exciters, etc.

Such an exploration is in progress. What it elicits should provide a fair cross-section of the educational field. The approach would not need to "sell" the intriguing technical and non-technical opportunities for careers in the power field. Alert professors know well enough how fertile the field is for recruits with initiative, ambition and imagination. What the power industry wants to know is—how many of the deans and faculties are not only conscious of these potentialities but are doing something to serve them.

Law As It Should Be Wrote

THE ELECTRIC UTILITY industry has an annual report contest. Yearly, as its winners are announced, the thought recurs that what is needed is a similar contest aimed at improving the contents of judicial opinions.

When some one opens such a competition, we have a sure winner. He is Wisconsin Circuit Judge Alvin C. Reis, the jurist who inflicted a deep freeze, recently, on the Wisconsin Public Service Commission's startling "Two Rivers doctrine." It's not just that Judge Reis tucked his tongue deep into his cheek and wove some uproarious comment into the piece. Much more than that, he made his decision unmistakable. He made his points so clearly that not even the untrained could miss them. The nuances which seem so dear to jurists may have been there. But so were the explanations of them. Just as the PSC failed to find any valuation of the Commonwealth Telephone property, Judge Reis failed to leave any confusing passages—or at least, none identifiable as such. Indeed, he didn't even let the reader reach the last page for formal notification of his reversal of the PSC order. At the top of page 2 he said this in so many words. If the American bench and bar fails to rise in wrath at this lese majeste, we'll be surprised. It's a good thing the bench isn't unionized.

With profound appreciation of what he has done for U. S. jurisprudence, we take leave of Judge Reis, quoting perhaps the best line in his opinion. Refusing to differentiate—as did the PSC—between the "police power" and the power of "eminent domain," Judge Reis remarked that "a rose by any name has petals of which we should be chary."

That's perfectly true, Your Honor. We can only add that an essay by any other name has metaphors of which even judges should be wary.

WASHINGTON COMMENT

W. B. WHICHARD

EVEN IN THESE INFLATIONARY, shortage-fraught times, a power system can build many miles of lines with a construction budget of a million dollars a day. That is the rate at which rural electric cooperatives and others seeking federal loans apparently propose to erect lines and related facilities. At least, according to the Rural Electrification Administration's annual report, applications for construction loans are being received by REA at a million-dollar-a-day clip.

Obviously, just to finance all these applications, without consideration of older, backlogged requests, REA would require a lending budget of $365 millions annually—366 in this Leap Year. Thus, it might be assumed that the $300 millions in lending authority requested for REA in the President's budget for the next fiscal year will just begin to meet the agency's most urgent requirements.

But it is unlikely that the economy bloc in Congress will be overly impressed. This group knows that REA cannot seriously consider the many applications which fail to meet its financial or engineering standards.

Also, the present Congress has displayed a growing inclination to examine the justification for loans which meet these standards and are approved by REA. For example, last year the Congress insisted that its Appropriations Committees be notified of any loan applications for generating facilities, before REA approved them as a supervisory measure.

At the same time, several Congressmen demanded that REA stick closer to its knitting. REA's prime activity, they asserted, should be financing distribution lines.

It is one thing, they pointed out, for farmers to borrow federal funds to bring power to their homes. It is something else again for the government to set up such groups in the more intricate phases of the utility business. Some people wonder whether the Congress which established REA in 1936 contemplated the creation of farmer-owned utility systems, generating and transmitting their own energy and otherwise functioning as utilities.

For much the same reasons, Congress may look askance at REA loans for offices, warehouses and related items.

In a single week recently, the agency loaned $65,000 to one co-op for construction of an office building, $9,650 to another for office equipment, $10,710 to a third to remodel its headquarters and $45,055 to purchase "office facilities," and $50,000 to still another for construction of an office and warehouse.

These funds represent a small proportion of total loans —$7,601,000—made by REA during the week. And REA claims, with unquestioned sincerity, that it tries to discourage such applications. But for obvious reasons, it will find difficulty in approving one co-op's application and turning down another.

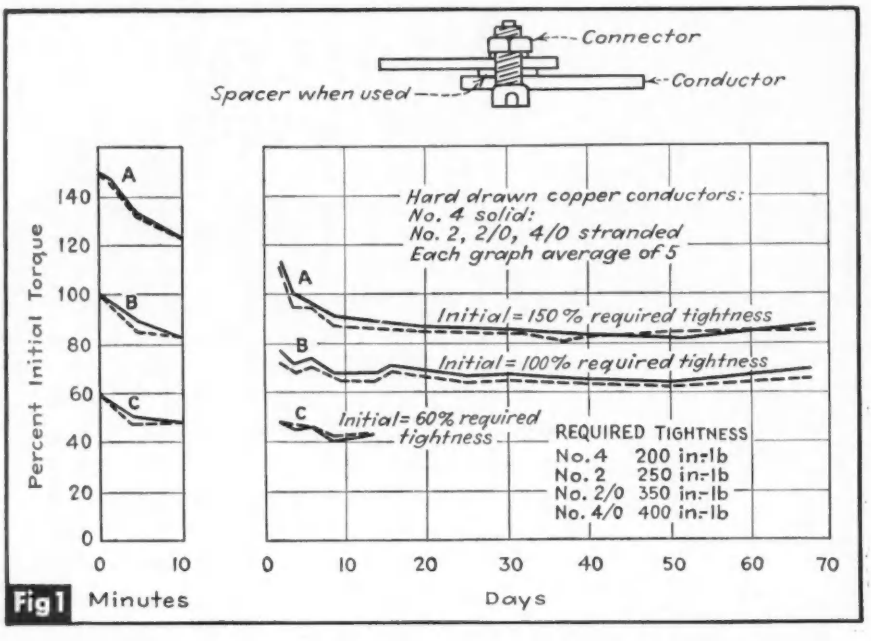


Fig 1

METAL FLOW of the copper conductors reduces the torque of split-bolt connectors about 35%. Much loss of tightness occurs in the first 10 minutes after installation.

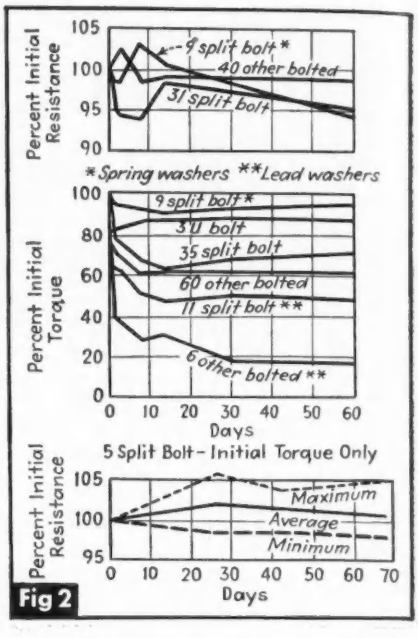


Fig 2

JOINT RESISTANCE is not seriously affected by the drop in torque

Connector Limitations Studied

R. M. SCHAHFER and W. H. KNUTZ
Northern Indiana Public Service Co
Hammond, Ind.

SPLIT-BOLT CONNECTORS have been failing at regular and frequent intervals for the past four or five years in the highly-industrial Calumet Region served by our company. Practically all of the failures have been on bare-conductor transmission and subtransmission circuits in a restricted high-load, high-fault-current area, where the atmosphere is very corrosive. Here, among steel mills, refineries, chemical plants and general industries, load growths have been rapid. Transformer capacities have increased. Sub-stations have been added. As a result, fault currents on transmission circuits have increased, reaching as high as 20,000 amp. Normal load currents are heavier than ever, but are still within safe conductor ratings.

We found many connectors with holes burned out of them, some a $\frac{1}{4}$ in. in diameter. Side walls of others were practically burned away. Some connectors were found red hot, observed from the ground by operators and the public. Enough heat was developed in some connectors to anneal the wires that they connected. Burning occurred on connectors installed both singly and in multiple. Many had pit marks $\frac{1}{16}$ in., radius and depth. A good many connectors that failed had been in service from one to three years. Practically every one that failed was on bare wire, untaped, and on a transmission or a subtransmission circuit. Trouble on distribution circuits was negligible.

Many connectors failed where short circuit currents of 20,000 amp would be experienced. But there were other failures where short circuit currents of only 5,000 amp would occur.

Cases of trouble were frequent and

TABLE I
Recommended Connector Torque

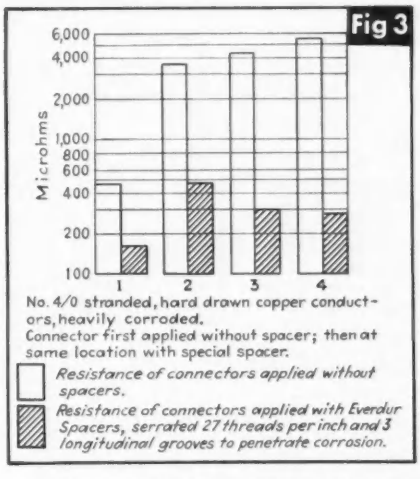
Connector Size	Required Inch-Pounds
6	180
4	200
2	250
1/2	300
2/0	350
4/0 to 250 MCM	400

TABLE II
Summary of Tests of 104 Sample Joints

Conductor Size		Desired Inch Pounds	PER CENT DESIRED INCH-POUNDS									
			TOOLS USED								Summary All Methods	
			One Wrench		Two Wrenches		One Plier		Wrench & Pliers			
Line	Tap		Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
4/0	4/0	400	102.0	37.8	91.2	91.2	137.5	27.0	121.0	75.0	137.5	10.7
	2/0	400	102.0	59.2	79.2	79.2	115.5	10.7	129.0	64.5		
2/0	2/0	350	113.8	97.5	115.0	115.0	86.1	40.0	153.5	95.2	153.5	21.4
	2	350	92.3	72.6	115.0	115.0	81.7	21.4	122.8	49.1		
2	2	250	108.5	77.1	76.8	76.8	79.3	28.0	137.7	56.0	137.7	24.4
	4	250	108.5	77.1	76.8	76.8	96.8	24.4	107.5	56.0		
4	4	200	80.5	70.0	90.0	90.0	126.5	42.0	.....	.....	126.5	32.5
	6	200	96.1	80.5	96.1	96.1	110.0	32.5	.....	.....		
		Min.	37.8		76.8		10.7		49.1		10.7	
		Max.	113.8		115.0		137.5		153.5		153.5	

damaging enough to inspire an intense investigation of all split-bolt connectors. Our company has been using them on connections not under line tension, regardless of voltage, for many years.

In our study we were guided by the following principles: We did not want to return to the soldering pot. We wanted a device that didn't require a special tool but could be installed with a Crescent wrench, the tool found on the belt of practically every lineman. We would accept a special tool, if it wasn't unwieldy, rather than return to soldering. Any device was desirable that would free us of dependence on good workmanship, such as adequate wire cleaning and sufficient tightening.



LOWER CONNECTOR RESISTANCE results from the use of serrated spacers with split-bolt connectors. Serrations apparently penetrate external corrosion

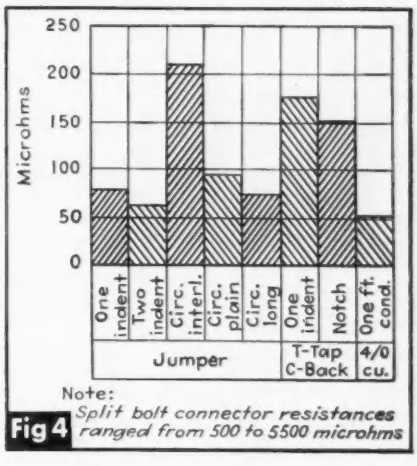


Fig 4

RESISTANCE OF JOINTS made with compression-type connectors varies considerably depending on the type and pattern of the indent

Connectors Must Be Tight

Early connector failure reports told us that connectors were found loose. They might not have been tightened enough when installed. So we began by studying methods used by linemen to install connectors.

We had 13 linemen in four operating districts of the company make up 104 joints just as they would on the job;—no better, no worse. Each man made eight joints; two each on No. 4, 2, 2/0 and 4/0 conductor, with the tools he normally used. Some joints were made with one wrench; some with two. Some were made with pliers and some with a wrench and pliers.

We checked these joints for tightness, or torque, and compared them with torque values (Table I) that were established as desirable.

Workmanship varied over a wide range. Sixty-nine percent of the connectors had less than recommended torque. No one man made all his connections to full recommended torque. This may be important because failure occurs, not to the average connection, but to *bad* ones. Tightness didn't depend on the size of the connector.

It was obvious that tightness depends on the judgment of the workman, and to some extent on the tools used. Since various types of tools were used to make the 104 sample joints, we made an analysis (Table II) of the torque obtained with the different tools. It showed a slight preference for two tools instead of one, and a further preference for two wrenches. But results, even with two wrenches, cannot be called satisfactory.

It was concluded that joints *must* be tight initially. We hoped that a properly made joint would remain satisfactory. But this remained to be proved.

The next step was to find out if connectors would vibrate loose if properly tightened initially.

Thirty-two connectors of various sizes, all tightened to required torque, were vibrated upwards of 14,000,000 times. Connector nuts were marked so any turning would be noticeable immediately.

The nuts did *not* turn. But there was a considerable loss of torque on the connector! Two explanations presented themselves. Either the connector elongated or there was a change in the conductor—possibly metal flow.

Elongation Suspected

To find out if connector stretch caused the loss of torque, five 4/0 connectors were applied to two ½-in. steel rods. Being steel, they would not deform appreciably under the low stresses that are commonly used in connectors.

The five connectors were tightened to 800 in.-lb—double the recommended torque—and micrometer measurements made along the length of the connector from head to end of thread.

Average elongation at the required torque was only 0.00106 in. Nearly all of this elongation occurred when stress was applied. It did not increase progressively with time, was of negligible degree, and the connector returned to nearly its original length

Conclusions In Brief

1—Any joint will cause trouble that had resistance high enough to cause heating.

2—Workmen can't be counted on to clean or tighten all bolted-type connectors properly. It is difficult for them to know when connectors are tight enough.

3—Joints subject to high short-circuit currents must have low resistance.

4—No connector failed that had a resistance of 100 microhms or less. The resistance of connectors for the service under discussion, where short circuit currents are from 5,000 to 20,000 amperes, should never exceed 100 microhms.

5—Split-bolt, single-bolt, two-bolt or almost any mechanical joint, properly tightened on clean wire, is satisfactory *initially*.

6—Most bolted joints are not affected by vibration, thermal cycles or connector elongation. Within two months of installation there is a loss of tightness, or torque, due to conductor metal flow. Resistance during this period remains almost unchanged, however, *if there is no corrosion.*

when the stress was relieved. Maximum loss of torque was from 800 to 768 in.-lb—only four percent of the initial torque.

None of these observations was typical of the torque loss found with copper conductors. Apparently then, connectors were being used well within allowable stress limits and elongation wasn't the cause.

Conductor Metal Flow

But it remained to determine the effect of conductor metal flow on conductor tightness.

Accordingly, connectors were tightened to recommended 100 percent torque values of Table I on hard-draw copper conductors, No. 4 solid, and No. 2, 2/0 and 4/0 seven strand. Other connectors were tightened to 60 and 150 percent of these values. Results are recorded in Fig 1. Five and ten-minute values were obtained in one set of tests. New tests were made to get the longer-time results.

As the curves of Fig 1 show, a large percentage of the metal flow occurred in the first five minutes. And, the lower the initial tightness was, the sooner final value of tightness was reached. There was no common value for different initial torque values. High initial torque resulted in high final torque, compared to values that were initially low. Spacers had little or no effect on the results obtained.

Findings of this test, and the connector elongation test, showed that conductor metal flow could contribute to loss of torque in split-bolt connectors.

The importance of this observation led us to repeat the test. This time we used a larger number of specimens, including other types of bolted connectors. We also studied the effect of conductor flow on resistance of various types of connections.

TABLE III
Resistance of Joints in Service—Summary

Microhms	4/0 Connectors			2/0 Connectors			4/0 & 2/0 Connectors		
	No.	Exceeding Value Shown No.	%	No.	Exceeding Value Shown No.	%	No.	Exceeding Value Shown No.	%
0–25	0	53	100.0	0	47	100.0	0	100	100
25–50	0	53	100.0	3	44	93.7	3	97	97
50–75	4	49	92.5	6	38	80.9	10	87	87
75–100	15	34	64.2	3	35	74.5	18	69	69
100–125	13	21	39.7	10	25	53.2	23	46	46
125–150	5	16	30.2	7	18	38.3	12	34	34
150–175	3	13	24.5	4	14	29.8	7	27	27
175–200	2	11	20.6	4	10	21.2	6	21	21
200–225	0	11	20.6	0	10	21.2	0	21	21
225–250	0	11	20.6	0	10	21.2	0	21	21
250–275	1	10	18.9	0	10	21.2	1	20	20
275–300	1	9	17.0	2	8	17.0	3	17	17
300–325	0	9	17.0	1	7	14.9	1	16	16
325–350	2	7	13.2	1	6	12.8	3	13	13
350–375	0	7	13.2	0	6	12.8	0	13	13
375–400	0	7	13.2	0	6	12.8	0	13	13
400–425	0	7	13.2	0	6	12.8	0	13	13
425–450	0	7	13.2	0	6	12.8	0	13	13
450–475	1	6	11.3	1	5	10.6	2	11	11
475–500	0	6	11.3	0	5	10.6	0	11	11
500–525	1	5	9.4	0	5	10.6	1	10	10
525–550	0	5	9.4	1	4	8.5	1	9	9
550–575	0	5	9.4	0	4	8.5	0	9	9
575–600	0	5	9.4	0	4	8.5	0	9	9
600–625	0	5	9.4	0	4	8.5	0	9	9
625–650	0	5	9.4	0	4	8.5	0	9	9
650–675	2	3	5.7	0	4	8.5	2	7	7
675–700	0	3	5.7	0	4	8.5	0	7	7
Over 700	3	0	0	4	0	0	7	0	0

Average Resistance	584 Microhms	240 Microhms	412 Microhms
Those Exceeding 700 Microhms	2,700 5,300 15,000	717 730 1,000 2,500	

The above resistances include 1 foot of conductor.
Resistance, one foot 4/0, 7 Strand, H. D. Copper Conductor = 52 Microhms.
Resistance one foot 2/0, 7 Strand, H. D. Copper Conductor = 83 Microhms.

In the second test, 125 solderless connectors of 13 manufacturers were used. Of these, 55 were of the split-bolt type and 70 were other bolted types, including 2-bolt, 4-bolt and 6-bolt types. Some of the connectors had spacers supplied by the manufacturers, and on others, a special one of our own design. Some spacers were smooth copper, some lead and some hard metal with sharp teeth—both cast and machine cut.

The loss of torque and its effect on resistance of the connection, observed in this second set of tests is illustrated in Fig 2.

Test Conclusions

This series of tests developed the following conclusions:

1. When properly tightened on clean conductor, all mechanical connectors tested made a joint that was satisfactory *initially*.

2. Metal flow reduces torque to about 65 percent of initial value for split-bolt type solderless connectors and to about 50 percent for bolted types.

3. Lead spacers cause greater loss of torque and an increase in joint resistance. In 60 days one connection rose to 484 percent—others 169 percent of initial resistance.

4. Other spacers had little effect on loss of torque. Some special designs with teeth actually reduce joint resistance when used on corroded conductor. (These later proved unsatisfactory on corrosion test.)

5. Split-bolt connectors with spring-lock washers show little loss of torque due to metal flow, but show no improvement in joint resistance. (Later corrosion tests showed them no better than other split-bolt types.)

6. Under normal uncontaminated atmospheric conditions, resistance values appear to undergo practically no change due to metal flow. Such changes as are indicated in the graphs are probably due to temperature coefficient.

Periodic Tightening

These resistance values were somewhat influenced by periodic tightening to check torque. Five split bolt type connectors were checked for a period of 68 days with no tightening. Result is shown as the lower graph of Fig 2.

We have already noted that some

connectors became so hot that they glowed at night. This is due of course to the combination of a high resistance connection and heavy line current. Such cases are not uncommon. They show that connectors in service are subject to temperature changes over a wide range due either to changes in ambient temperature or load current. Connectors are installed under all temperature conditions. Expansion and contraction due to later temperature changes *could* effect connector torque.

To check this possibility, sample joints were made up at 80 F; others at 0 F for a day, then reversed each day for five days—then again held constant at about 75 F for 23 days. Finally the original daily reversal was repeated for 6 days.

Torque loss readings revealed the typical curve for metal flow obtained when the temperature was held constant. There was no apparent difference between test connections made at 0 F and those made at 80 F. Evidently then, initial temperature, or changes of temperature, do not significantly affect loss of torque in split-bolt connectors.

Connector Resistance

To evaluate the resistance of split-bolt connector joints that are failing, lines were taken out of service. The resistance of the connector joint was measured in position by means of a bridge.

One hundred connections: 53 on No. 4/0 and 47 on No. 2/0, seven strand, hard-drawn copper conductor, were measured. Results are tabulated in Table III. All resistance measurements include one foot of conductor.

This table shows that 60 percent of the joints had a resistance in excess of 100 microhms—a value, as laboratory experiments indicate, that will be unsafe on short-circuit current of 18,000 amp.

Conditions in the field would, doubtlessly, have been much worse if it was not for the fact that many, many connectors had been removed in the previous two or three years due to burning. Average joint resistance reduces from 412 to 143 microhms if the 7 extra-high resistance joints are eliminated. However, trouble can be expected on any connector with values exceeding 100 microhms.

Conductors have a good semi-circumferential fit in the head of all connectors. This is also true of the nut-end of some connectors. But, conductivity is from conductor-to-conductor, rather than from conductor to connector. Contact area from conductor to conductor is long and quite narrow, particularly on stranded conductors. Under pressure, multi-strand connectors can compact easier if the force is concentrated instead of distributed. Hence, certain manufacturers recommend the use of a spacer between the conductors. This spacer fits the conductor semi-circumferentially, will provide more contact area, and is supposed to reduce metal flow. Fig 3 shows that commercial spacers do not affect metal flow characteristics very much, regardless of whether the connector is 100, 150 or 60 percent of recommended tightness.

Spacer Experiments

Being aware that high resistance was causing connector failures, we experimented with specially-designed spacers of soft and hardened copper with smooth, serrated and grooved surfaces. Everdur and aluminum bronze spacers with cast and machine-cut projecting teeth were tried. Cast lead spacers were tried. Various lengths from 2 to 7 in. were used. Spacers were applied to both clean and well-corroded conductors.

Copper spacers showed no improvement in resistance. Everdur and aluminum bronze, with properly designed projections, penetrate the corrosive surfaces of the conductor and lower the joint resistance as shown in Fig 3. Lead spacers flow around the conductor and shield part of the conductor from corrosive atmospheres. They are mechanically weak however, and reduce the initial resistance of the joint but little.

We believe that hard-metal spacers, of proper design, can be used benefically if short circuit currents are not too great. They reduce the dependence on workmen cleaning a joint properly.

Other Bolted Connectors

Thus far this article has dealt with split-bolt type connectors. Consideration of other bolted types is important because many of them are applied with the same tools we are now using for split-bolt connectors.

TABLE IV
Metal Flow on Bolt Type Connectors

	Number of Connectors	Initial Inch Pounds	Final Inch Pounds	Per Cent
NEW CLEAN CONDUCTOR				
U Bolt	7	400	280	70
Single Bolt	9	200	96	48
2 Bolt	21	200	123	61
4 & 6 Bolt	9	200	123	61
WEATHERED CONDUCTOR				
Single Bolt	3	200	131	65
4 Bolt	4	200	110	55

Table IV shows results of metal flow tests on various bolted connectors other than split-bolts.

Resistance before corrosion changed very little during metal flow on new, clean conductors. On unclean, weathered conductors, resistances were unpredictable.

Compression-type connectors were also tested. They were made to retain as much water in the joint as possible. The joints were then frozen and thawed through several cycles. Practically no change in joint resistance was noted.

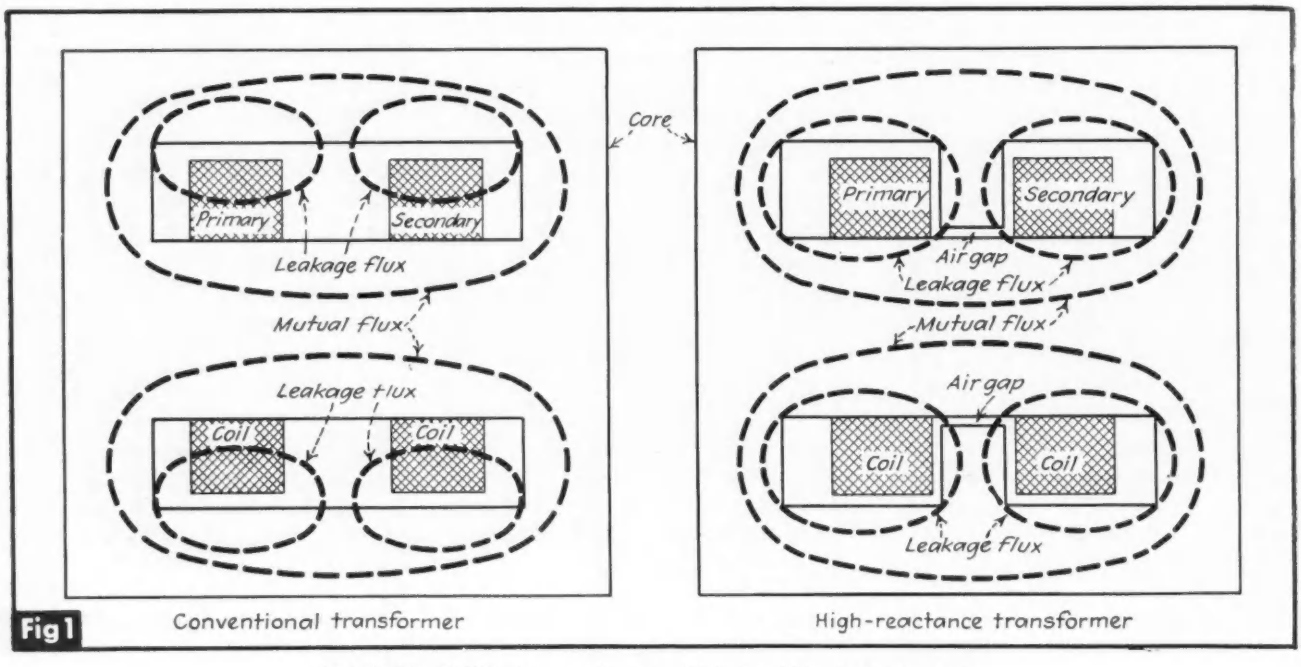
Compression connectors were next vibrated for 100 hours. Again, practically no change in resistance was found in joints made on new, clean conductors. Resistance of joints on weathered conductors increased a little in four joints. There was a marked increase in two.

Breaking Strength

Some compression joints reduce breaking strength of the conductor in sizes used for overhead construction. This may be as much as 10 percent. Joints made with a uniform compression pattern, however, do not materially reduce conductor strength.

Compression connectors are initially tight. Workmen operate the compression tool until pressure is automatically released. For a given compressor, die and conductor, this provides uniform and high degree of pressure.

Weathered conductors should of course be well cleaned before applying compression joints. If, however, this part of the work is slighted, a reasonably low resistance joint will generally be obtained, because, in compressing the sleeve around the conductor, there is an abrasive effect between conductor surface and inner sleeve surface. This effect is shown graphically in Fig 4.



LEAKAGE FLUX is greatly magnified in high-reactance transformers by added core metal. Air gap controls load characteristics

High-Reactance Transformers Supply

J. A. UTTAL
General Electric Co
Fort Wayne, Ind.

At our request a specialist in the peculiar qualities of transformers for ignition, neon lighting and similar applications, tells how they get that way and why

NOT ONLY in luminous-tube lighting and ignition service will you find high-reactance transformers. They have become important factors in high-intensity lighting systems, purification processes and even radio transmission. For those, such as utility power salesmen, who meet these current limiting devices only as encased in sheet metal, here follows a brief review of their characteristics.

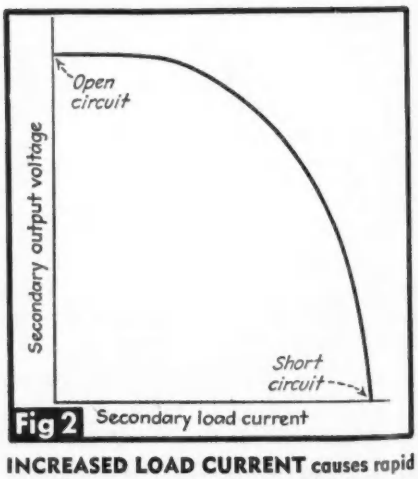
These transformers perform simultaneously as reactors and conventional converters of voltage. Acting as transformers, they provide proper load voltage. Acting as reactors, they serve to limit load current.

Fig 1 compares, schematically, the construction of a shell-type transformer with a conventional high-reactance transformer having additional steel core material between primary and secondary windings. Although conventional "normal reactance" transformers are usually designed with the windings placed concentrically over the core, in order to indicate more clearly flux distribution, Fig 1 shows them situated adjacant to each other.

Each coil is linked by two flux components, one "mutual" with another coil and the second "leakage". The mutual flux alone is responsible for voltage being obtained from the secondary coil. No load voltage, in any transformer, is directly proportional to the turns in the respective windings, because leakage flux is negligible.

On transformers for power applications it is desirable to maintain a near-constant secondary voltage, independent of secondary load current. To accomplish this, the designer of power transformers makes the leakage reactance as small as possible. However, we are concerned with the opposite purpose. We want appreciable reactance in series with the load.

By separating the primary and secondary windings somewhat, rather



INCREASED LOAD CURRENT causes rapid fall-off in output of voltage of high-reactance transformer as short-circuit conditions are approached.

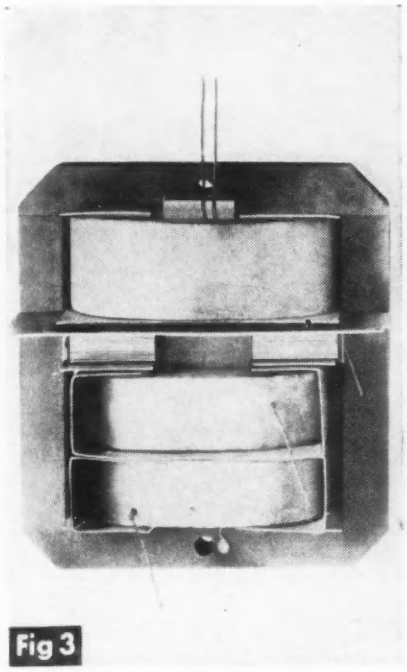


Fig 3

IGNITION TRANSFORMER has two secondary coils in series, mid-point grounded

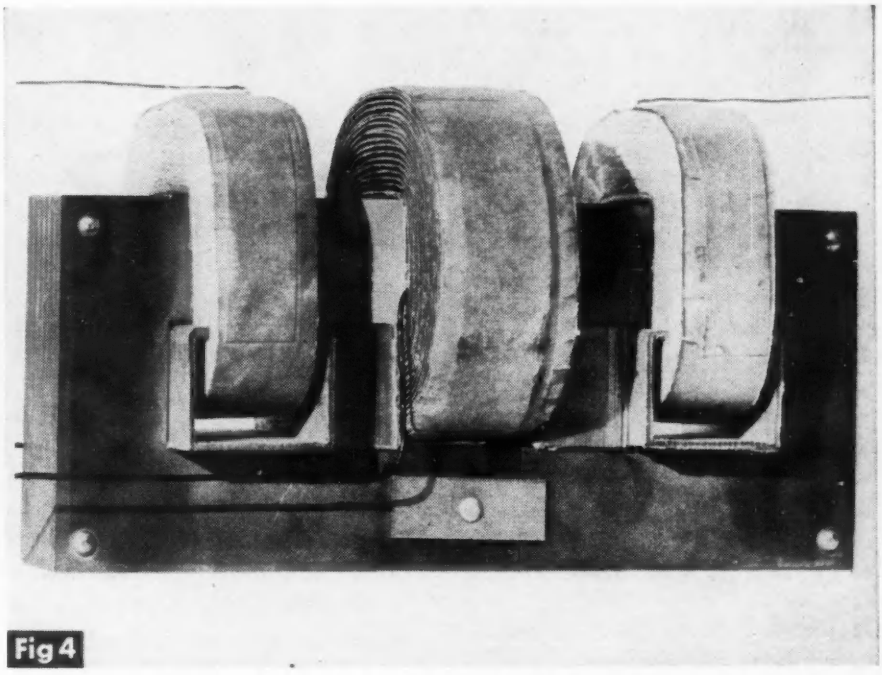


Fig 4

CORE AND COILS for luminous-tube transformer showing series-connected secondary coils, midpoint grounded, on either side of primary

Limited Load Current For Many Uses

than arranging them in concentric fashion as is best for power transformers, and by introducing added steel core material in a position to increase leakage flux, we can produce a high-reactance transformer. By proper proportioning of the "magnetic shunt" and air gaps it is possible to obtain predetermined values of leakage flux, and corresponding reactance.

Under no-load conditions the magnetic reluctance of the leakage path, because of the air gap, is much greater than the path of "mutual" flux, and the secondary output voltage approaches that corresponding to the turn ratio. As secondary load approaches short-circuit conditions, usual for high-reactance transformer applications, the current in the secondary coil opposes the primary flux which produces voltage in the secondary coil. This opposition effectively increases the magnetic reluctance of the "mutual" flux path and more of the flux travels through the magnetic shunt provided for it.

When secondary load approaches a short circuit, only sufficient secondary voltage remains to maintain a predetermined value of the short-circuit current. All other factors remaining unchanged, the magnitude of secondary current depends on the relative magnetic reluctances of the secondary magnetic path and of the shunt path. If the reluctance of the shunt path is increased with respect to that of the secondary circuit, the secondary short-circuit current is increased. Conversely, if the shunt path reluctance is lowered, the short-circuit current is decreased. An air gap, measured in thousandths of an inch, determines the load characteristics of a high-reactance transformer, although there are, of course, other factors affecting transformer leakage reactance.

For example, there are some types used for high voltages in which the magnetic shunt is not necessary because the spacing between primary and secondary windings must be great to meet insulation needs. In these, leakage reactance is high merely because of coil spacing.

If open-circuit voltage, or voltage at a definite load, and maximum allowable short-circuit secondary current are accurately specified, the transformer designer can make a close approximation to proper physical proportions. However, a detailed discussion of design is not necessary here; rather the requirements of certain applications are more to the point.

Among the applications of high-reactance transformers is the ignition of domestic and industrial oil burners. To develop a spark between the electrodes through which atomized oil passes, an initial potential of about 10,000 volts is required. However, once the arc has been established, only about 3,000 volts is required to maintain it. In addition, the arc has the characteristic of practically constant voltage drop despite increasing current. If no external impedance were inserted in the circuit, the arc current could increase until electrodes and other parts of the electrical system were destroyed. The transformer must provide 10,000 volts at no load to strike the arc and have sufficient impedance to limit current to a few milliamperes after the

arc has already been established.

Fig 3 shows one typical construction. Two secondary windings are separated from the primary winding by magnetic shunts. Secondary windings are mid-point grounded to keep voltage stress at a minimum. In addition, this construction provides maximum freedom from radio interference produced by oscillations generated in the arc. Shields also can be placed between primary and secondary windings to eliminate radio-frequency transfer back through the transformer windings.

Another important application is the wide field of luminous (neon) display and advertising signs. The arc, passing through a gas-filled glass tube, can be used either as a direct source of light or the tube can be coated with a fluorecesent powder and the arc current used to produce light by fluorescent action.

The fundamental electrical requirements of luminous-tube lighting are quite similar to those of ignition transformers. A high break-down voltage must be provided and then arc current must be limited to a value best for long life and optimum light output. Arc break-down value and current are determined by length and size of tubing, gas used, humidity and ambient temperature. The innumerable varieties of signs now in use require many types of transformers.

One design of luminous-tube transformer is shown in Fig 4. The primary winding, between two secondaries, has magnetic shunts on each side. Locating secondary windings on opposite sides of the primary coil permits practically independent operation of each secondary. If one fails, the short-circuit arc current in the other will not be appreciably affected.

Additional Applications

The inherent low power factor of luminous-tube lighting can be overcome by adding capacitors. These may be added within the transformer or separately.

Other important uses of high-reactance transformers include lamps dependent on the electric arc as a source of radiation. Special sodium-vapor, mercury vapor, and certain sun lamps operate on this principle. These and similar units are used in high-intensity lighting systems, purification processes and for producing ultraviolet light. All of these applications present problems similar to those of luminous-tube and ignition transformers. However, in most cases, the arc-striking voltage is not as great as for ignition or sign-lighting.

Another interesting use of high-reactance transformers is for heating filaments of large electronic tubes. Filament resistance for such tubes at room temperature may be only one tenth of that encountered in normal operation. Initial current for large tubes used in radio transmission and x-ray equipment may be large enough to destroy the tube, if sufficient impedance is not included in the starting circuit to limit inrush current. Rather than attempt a tube design mechanically capable of withstanding the magnetic forces associated with high inrush current, it is frequently more practical to utilize a high-reactance.

Because it can limit the current in an electric arc, the high-reactance transformer, equipped with taps, can be used to control electric furnaces. Voltages involved are quite low, but considerable amounts of power are involved.

Another interesting application is found in simple household devices such as door bells, furnace regulators and toys. For these, underwriters' regulations or other design considerations require that amounts of energy taken from the primary supply be definitely limited when load on the transformer is short circuited. To minimize fire hazards, requirements are quite stringent and in many instances a high-reactance transformer is exclusively specified.

Electrically Pumped Rain Increases Crops

SUPPLEMENTAL IRRIGATION by electric pumping is increasing values in vegetable production on the Charles C. Geraty truck farm on Yonges Island in South Carolina. Replacing previous smaller scale irrigation using gasoline engine pumps, the electric installation has resulted in a reduction of a quarter to a third in operating cost. It has practically doubled the yield—5 crops of beans per season as against 3 previously—and has wholly removed dependence on rainfall. This is particularly helpful during dry seasons.

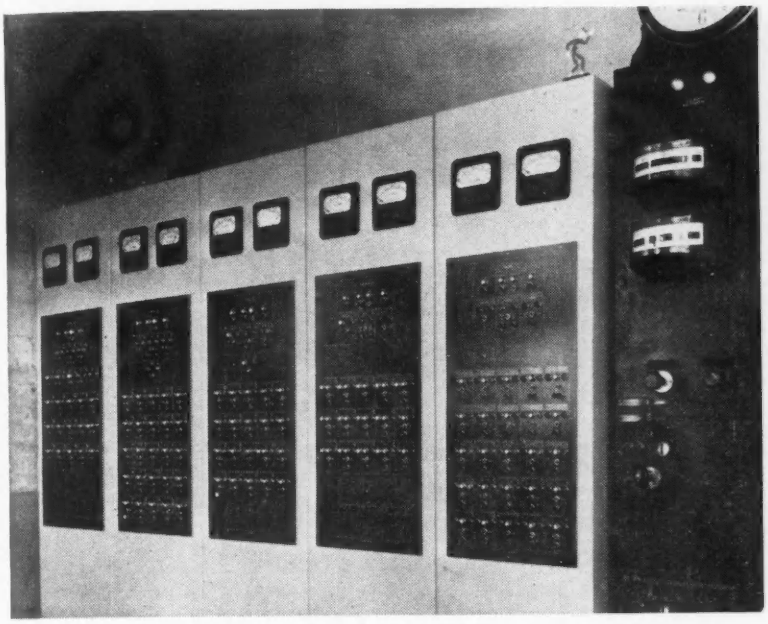
The system uses 6 centrifugal pumps; 5 of them, driven by 1½-hp motors, are in continuous service pumping water from 40-ft wells into an 8,000-gal storage reservoir. The sixth pump, of 25 hp, delivers water at 100-lb pressure and at 700-gpm rate to mains laid permanently along the sides of the field. Outlet valves and turn-offs are spaced at 300-ft intervals along the mains. To these are connected movable sprinkler pipes laid on the ground. The sprinkler pipes are of light metal and are easily handled. They are equipped with lever-operated couplings so that sections can be connected and disconnected quickly.

Spray from one pipe covers an area 30 ft wide on each side. Operation for 1½ hrs provides irrigation equal to one inch of rain. Use of electricity for gathering from the wells and for spraying averages about 5.5 kwh per inch-acre of watering.

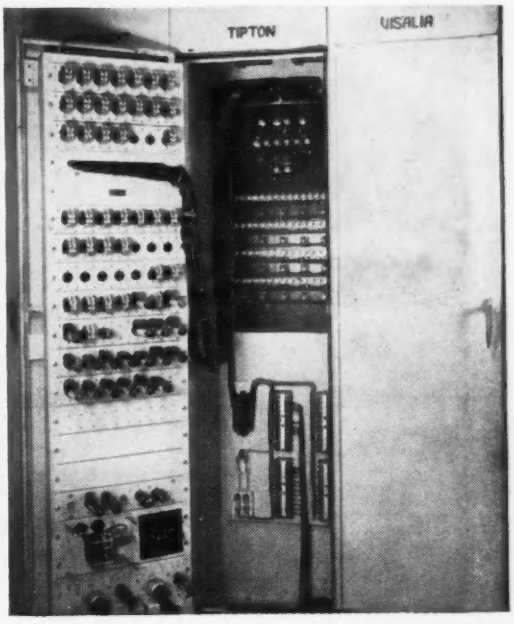
CORRECTION

Two errors appear in the tabulation of new capacity on pages 147-149 of ELECTRICAL WORLD's 1948 statistical number, published January 17. The listing of hydro under "Generating Capacity Added in 1947" on page 147 should have been printed on page 149 under the heading, "Generating Capacity To Be Added in 1949 and Later", and the hydro list appearing there should have been in the 1947 tabulation.

The total of 1947 hydro capacity installed by power companies should be 54,750 not 27,750 kw. This corrected figure changes the total new capacity added during 1947 in the table on page 146 to 2,203,749 kw. Corrected pages, suitable for insertion, will be furnished upon request.



MASTER SUPERVISORY CONTROL switchboard at dispatching station, combining operating, indicating and telemetering functions for several controlled substations. Indicating instruments at top of board can read volts and amperes of any desired remote circuit, or switching operations can be accomplished simply by setting proper toggle switch and depressing button



REAR of master supervisory control unit showing tuned frequency telephone type plug-in relays mounted on swinging panel. For easy maintenance panel is accessible front and back when unlatched and swung back from door

Supervisory Control Permits Decentralization of Large Systems

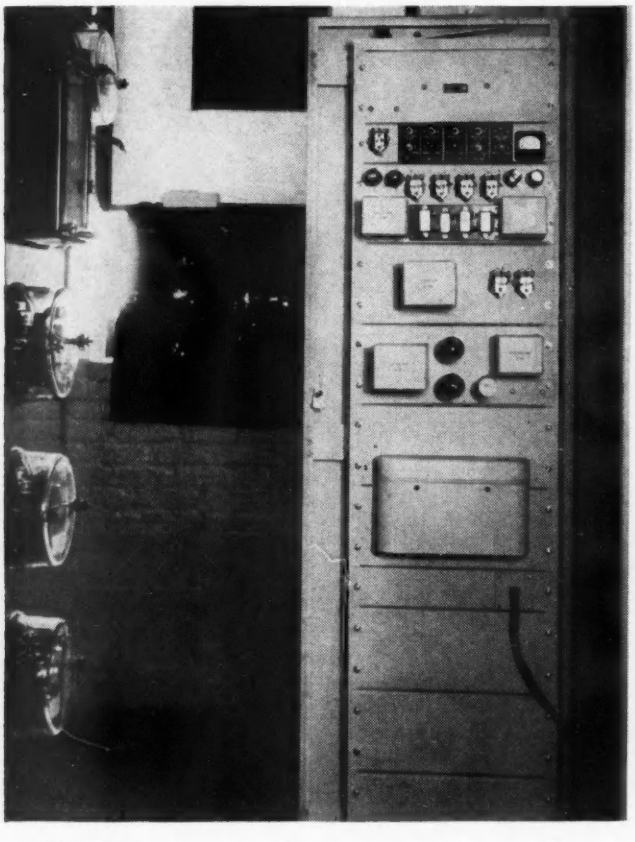
Greater operating flexibility and speedier restoration of service are attained by supervisory control of a number of small stations from key dispatching points

FIRST STAGE in a million-dollar program of the Southern California Edison Co to effect decentralization of system control is nearing completion in the San Joaquin Valley division of the company. The systemwide program provides for equipping some fourteen strategically located dispatching stations to control approximately 50 important substations and provide remote alarms from about 100 smaller stations. The several factors governing the choice of control channel and type of equipment used on this system are discussed in an article on "Analysis and Selection of Supervisory Control" in the Sept. 28, 1946 issue of *Electrical World*, p. 112.

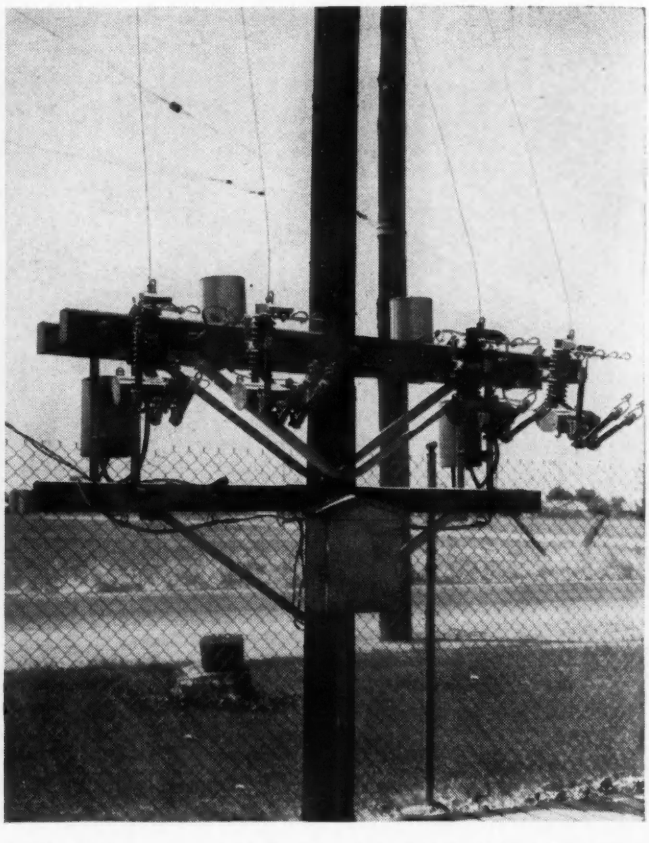
Briefly, in determining the control channel which would offer the most economical and reliable operation, three were considered—carrier current, cable and open wire. Use of carrier current was ruled out because the continuity of the channel could not be assured during the time when the control would be most urgently needed. Serious consideration was given to the use of multiconductor aerial cable. But previous operating experience dating back to 1927 had shown lead-covered, dry paper-insulated, telephone-type cables to be unsatisfactory for this service because of low dielectric strength. The high db loss and high comparative cost of Flamenol insulated cable ruled against its use for this application.

The use of a single pair of No. 8 copper wires strung on 4-kv insulators on existing poles offered a substantial cost advantage over cable, in addition to providing a high insulation value of air and porcelain which reduced the problem of low shunt resistance due to leakage. Further, by supplying all power for the equipment from station batteries, a control system was obtained which operates entirely independent of any abnormal conditions in the power system.

To operate on the open wire circuit, a control system utilizing audio-frequency signals operating tuned receiving relays was chosen. Such a system is not seriously affected by leakage due to lowered insulation re-



AUXILIARY control cabinet door, showing fixed audio-frequency signal generating components and test switches. These switches, top of panel, can be used to transmit any of the fixed frequency operating signals continuously for testing or trouble shooting



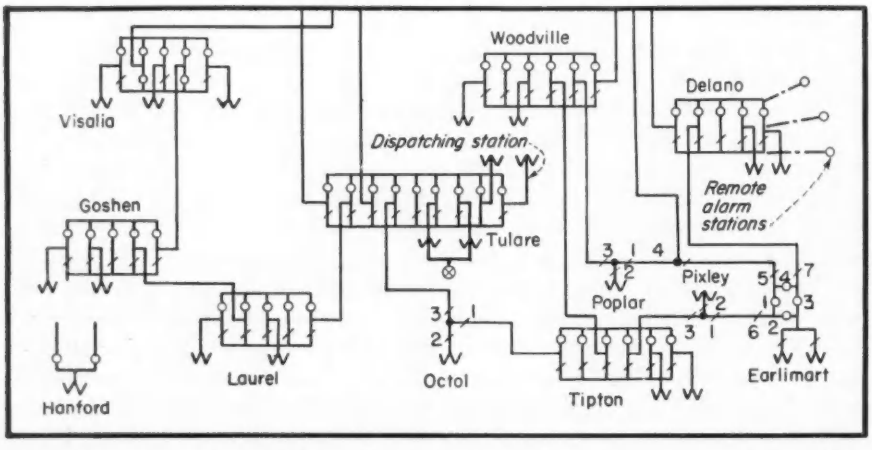
TERMINAL of open wire carrier channel with 11-kv power type three-shot reclosing fuses, enclosed surge and lightning protection gaps, and insulating transformers especially designed to pass the required band of audio frequencies from 200 to 10,000 cycles

sistance under wet or fog conditions. Excessive leakage would be a definite problem on a circuit using direct current impulse signals. It is interesting to note that the equipment as installed can operate with practically a short circuit shunt resistance reading on the line. One further advantage of the audio-frequency equipment is the protection afforded by telephone type insulating transformers, especially designed to pass the required range of frequencies. These transformers, along with the three-shot, 11-kv power type reclosing fuses for line protection, are shown in one of the accompanying photographs.

Master Control

The control panel is laid out in an orderly arrangement which combines operation, indication and telemetering by push button and toggle switch control. Operation is accomplished by depressing the proper button and maintaining contact during the time the sequence of audio-frequency signals is automatically transmitted to the controlled substation. The proper tuned receiving relay responds and completes the circuit necessary to perform the desired operation—for example, closing a breaker, which in turn sets up another circuit to send back an indication of the operations having been completed.

Four or five fixed audio frequencies spaced approximately 85 cycles apart, from 200 to 500 cycles are used for operation depending on the number of separate functions which must be performed. Return signals for completed operations are in the 3,000 to 10,000 cycle band, which also includes telemetering. Depressing the proper telemetering button for volts or amperes on a given circuit sends out a sequence of frequencies which picks up a relay sending the desired current or voltage into the telemetering transmitter. Here it is measured by a standard indicating instrument element. The position of the instrument needle is scanned photoelectri-



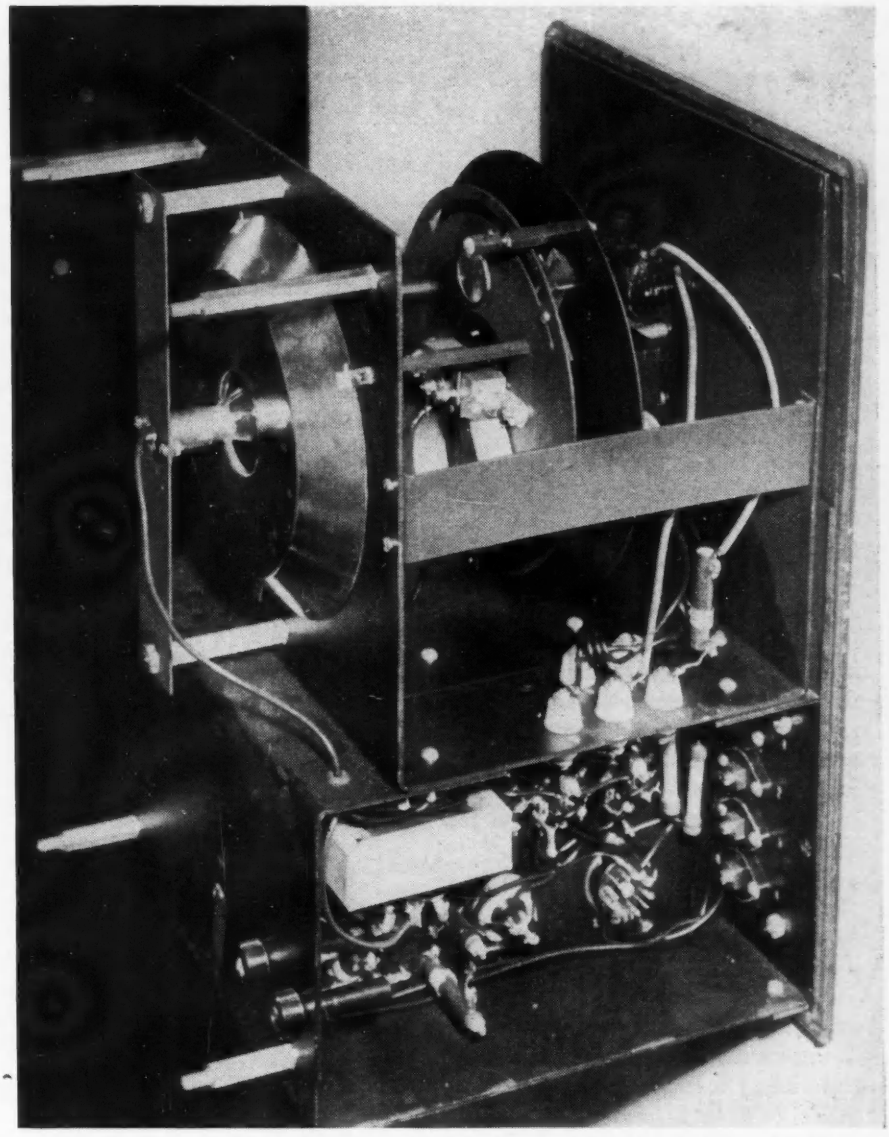
PORTION of San Joaquin Valley system to which supervisory control was first applied

cally by a revolving optical system shown in the accompanying photograph. The magnitude of the reading determines the length of the signal transmitted back to the control station. Since the reading is identified by the frequency, from 3,000 to 10,000 cycles, and measured by the length of the returning signal, the system is independent of variable losses due to leakage on the line.

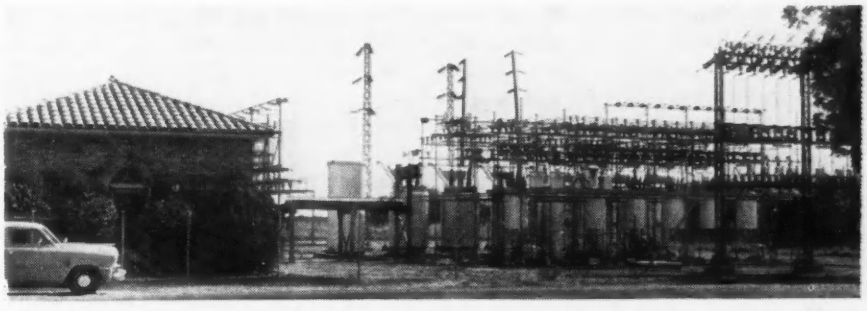
Continuity of the channel is monitored by transmitting a voltmeter reading with each revolution of the photoelectric system every seven and one-half seconds. Trouble shooting on the equipment is greatly simplified by test switches (shown in the accompanying photograph of the auxiliary compartment) which allows any of the audio-frequency signals to be sent continuously during testing.

Typical example of installations is the Edison Company's supervisory station at Tulare, Calif., and its several controlled substations as shown by one line diagram. Equipment supplied by the Electric Control Corp for this installation was ordered in the late summer of 1945 and put into operation the early part of this year. Six substations of the general type pictured stepping power down from 66 kv to 11 kv and ranging in size up to 15,000 kva are controlled from the master supervisory switchboard shown. Operation of any of the various functions at the controlled stations is initiated by setting the proper toggle switch in the desired close or trip position, then depressing the button directly beneath the switch until the proper sequence of fixed frequency signals has been sent out. Actual condition of each circuit is shown at all times by the indicating lights on the board.

In addition to operating functions, the system is used for both general and specific alarm indication; not only alarms from all of the controlled stations, but in several cases alarm circuits from small distribution stations in the area of a controlled station are brought in to the equipment and transmitted to the central dispatching station. Thus the lines of the communication systems are being relieved of some 100-150 insulating transformers previously used for remote alarms from unattended stations.



TELEMETERING TRANSMITTER used for sending signal to dispatching station which is proportional in length to magnitude of indicated volts or amperes. Left to right are a light source and reflector, permanent magnet of indicating instrument element, stationary masking disk with instrument pointer behind cut-out portion, and rotating disk driven by telechron motor and carrying focusing lens. Light from the source is focused by traveling lens to pass through cut-out arc of the stationary disk, when it follows path like a right angled "Z" through two prisms mounted on the moving disk. The beam parallel and close to the axis strikes a phototube mounted behind the moving disk. Interval between time light first strikes phototube and beam is interrupted by instrument pointer is determined by magnitude of indicated reading, and through an electronic amplifying circuit this reading is sent back to the dispatching station indicating instruments, shown in another photograph



TYPICAL of units supervised is this substation stepping down from 66 to 11 kv with a capacity of 6,000 kva. Not only can normal operation of the station be checked and coordinated from the dispatching station, but general and specific alarms from distribution stations located in the surrounding area can be fed in to the controlled station

Supervisors Study Union Relations

LYNDEN J. KAUFMAN
Union Relations Adviser
Detroit Edison Co
Detroit, Mich

GOOD working relationships between supervisors and union representatives are a must for keeping good employee relationships where workers are organized.

This means more supervisor training, and that isn't always easy. Fitting a special series of conferences into the schedule of a supervisory organization which is already loaded, is an unwelcome job. Often it doesn't win much favor, especially if the added conferences appear to duplicate ground already covered.

Still, this was Detroit Edison's problem—and many other companies face it today. In our case, it wasn't lessened by a desire to hurry the job. To make things tougher, our grievance record was comparatively good. Thus, we couldn't support additional training by formidable statistical evidence. No department, and no particular contract provision, seemed to be a trouble spot. Still, there was evidence of uncertainty and inconsistency in our day-to-day dealings with the union.

Based on our belief that performance could and should be improved, we designed a series of conferences. They aimed at:

1. Economizing on time.
2. Stimulating interest.
3. Improving knowledge and skill in operating under the union contract.

Results were good, although the program's value is not measurable statistically. That interest was stimulated, was demonstrated by favorable comment, participation in discussion and regular attendance. Knowledge was increased. We trust that increased skill will follow.

We invented no new methods, but we did modify some old ones. With happy results. The three factors which contributed to the success of our meetings were the following:

1. Specific backing by executives.
2. Multiple leadership of the conferences.
3. Use of real grievance records.

The program was started by the President. He stated the need for it briefly and asked company officers to see that it was properly supported. Within a few days, department heads were assembled by the Vice-President. He stressed the importance and the ground to be covered.

Our two-hour conferences—held every two weeks—were led by the director of employee relations. Two members of our centralized personnel department assisted him. About half the time was spent presenting material, and herein lay the reason for multiple leadership. The leader performed the usual functions of a chair-

Dealing With Unions

1. Apply the principles of good employee relations to dealings under the contract.
- **A. Tell employees (including their representative, the steward), in advance, of the things which will affect them.**
- **B. Let employees know where they stand.**
  - **1. Tell them what their pay will be for special working conditions; when absent; when called in; when working overtime, etc.**
- **C. Allow an employee (or steward) to air his complaint without interruption, to "blow off".**
- **D. Get all of the facts. Get agreement on facts, and as early in the case as possible.**
- **E. Decide on the basis of the facts — not emotion.**
- **F. Be fair, but firm. Do not "needle".**
  - **1. Enforce the contract, or disciplinary rules, impartially.**
  - **2. Take responsibility for handling the problem promptly. Get aid or advice, but do not "pass the buck".**
- **G. Accept problems, and even reversals of judgment, as opportunities to learn, to improve skill.**

Knowing The Rules

2. Understand the union contract.
- **A. The provisions, and their implications.**
- **B. The Grievance Procedure; its purpose, and operation.**
- **C. The purpose and limitation of arbitration.**

Protecting The Company

3. Understand the rights of the company; in the contract, outside the contract.
- **A. Management has right to run business according to its own best judgment, subject to:**
  - **1. Limitations expressed in contract.**
  - **2. Right of union to challenge abuse of power.**
- **B. Management has right to maintain discipline, subject to:**
  - **1. Limitations expressed in contract.**
  - **2. Right of union to challenge abuse of power.**
- **C. Management has right to act, subject to:**
  - **1. Limitations expressed in contract.**
  - **2. Right of union to bring grievance, have hearing.**

Protecting The Union

4. Understand the rights of the union.

A. The union is the official bargaining agent — and the only one — for the employees it represents.

1. Union must be consulted on proposed changes in wages, hours, working conditions covered by contract.

2. Union should be informed of proposed action, even where company is free to take it.

Understanding Unions

5. Understand the operation of the union as a social group, outside its bargaining relations with the Company.

(Note that no judgment is passed as to whether the following activities are good or bad. Companies, churches, lodges, and similar social groups may operate in exactly the same fashion *to maintain themselves as organizations.* This type of activity exists, and must be recognized as having an effect, independent of the objectives for which the organization exists. The purpose of stating these activities is to lead to a broader understanding — not to find fault or criticize.)

A. The union, to survive, must satisfy its members.

1. Officers, stewards present views of employees, which may or may not coincide with their own.

2. Officers may override wishes of substantial minority group, to please majority.

B. The union, though its constitution and by-laws may provide for democratic action, is usually run by a minority group of individuals who take the time and trouble to run it.

1. As social organization, it does not differ from government, lodges, or churches.

2. People are inclined to "Let George do it."

3. Officers are elective. They must please members to hold office.

C. Unions are concerned with more than one employer.

1. International organizations establish general policy.

2. Many employers are small —A. F. of L. Building Trades — Tool and Die Jobbing Shops — Trucking and Cartage Companies.

D. Unions tend to perceive, or respond to, only short-range objectives.

1. In the long run, many employers fail and go out of business.

2. Technological change throws union members out of work — changes skills — weakens union.

E. Unions are concerned with developing their own power and prestige as a social group.

1. Encourage a feeling of unity among workers.

(a) Political campaigns: newspapers, and educational, recreational and benefit program.

2. Protect their members and gains.

(a) Jurisdiction over work; number of apprentices; limitations on the hiring; "seniority" in promotions: standards of output.

man. His two assistants shared the talking and question-answering, thus shifting the spotlight from one person to another. This not only livened things, it also encouraged other members of the conference to join the discussion more freely. Informality and discussion were fostered by making shifts as frequently as was practicable. Interruptions to clarify or emphasize a point helped. This feature was particularly well received.

Actual Detroit Edison grievances were used to illustrate points and in discussions of principles. In most cases, they served as examples of what to avoid. In introducing the first ones, we had some fear of embarrassment on the part of the department involved. So we explained—and repeated it from time to time—that other departments also had made mistakes. We made it clear that these cases were selected chiefly because of their simplicity and the adequacy of their records. The explanation was accepted gracefully, and there appeared to be no sensitivity. Students commended the use of real records—preferred them to "manufactured" cases.

About forty department heads, assistants and staff employees attended these conferences. In turn they led conferences on the same information for supervisors in their departments.

Although the conferences were informal, all information was written. Also written were typical questions and their answers. Material was distributed before the meetings, prepared answers afterwards. Enough copies were furnished for the supervisors who would take part in later conferences. Thus, we made sure that all supervisors got the same message and that all conference leaders understood the subject thoroughly. Each supervisor was given a check list (Points 1, 2, 3, 4 and 5) as a reminder. This check list is the outline followed by the conferences.

In these conferences, we spent no time on Point 1 other than to review it. We have covered this very important point in other supervisory conferences; hence, we felt a reminder would suffice. Points 2, 3 and 4 were illustrated by real grievance records. Any company which deals with a union will have specific material covering them. Our time for discussion of Point 5 was limited, but we feel sure that supervisors would benefit from an even more thorough discussion of it. Discussion of this subject aroused less interest than some other points did; still, it was apparent that this aspect of unionism is neither understood nor properly evaluated by supervisors.

Philadelphia

NELSON YEAKEL
Chief Meterman
Philadelphia Electric Co
Norristown, Pa.

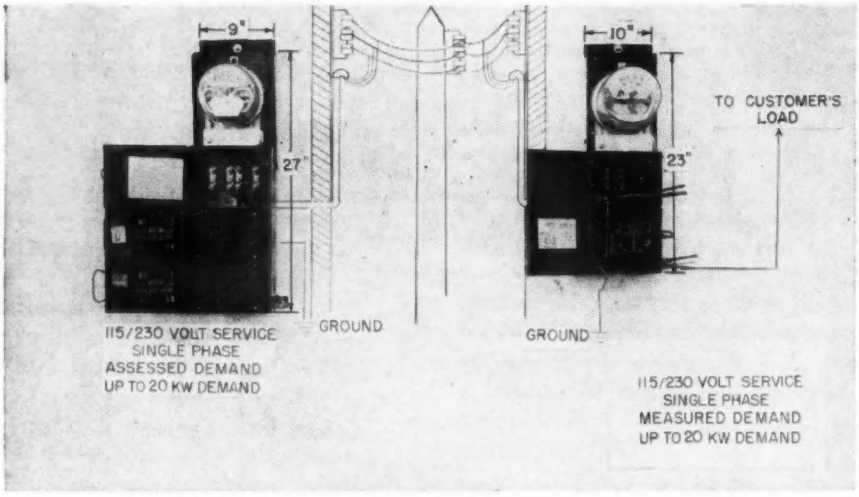
FOR EVERY CLASS of service offered by the Philadelphia Electric Co, there is a specific metering installation that is best suited economically and from a workability standpoint to the rate that applies.

Commercial and industrial sales engineers, in their contacts with customers, are required to be intimately familiar with these standards and the limitations that rate economics impose upon metering. Lack of such coordination between commercial and meter departments would otherwise lead to commitments for nonstandard metering installations that would be both wasteful and impractical.

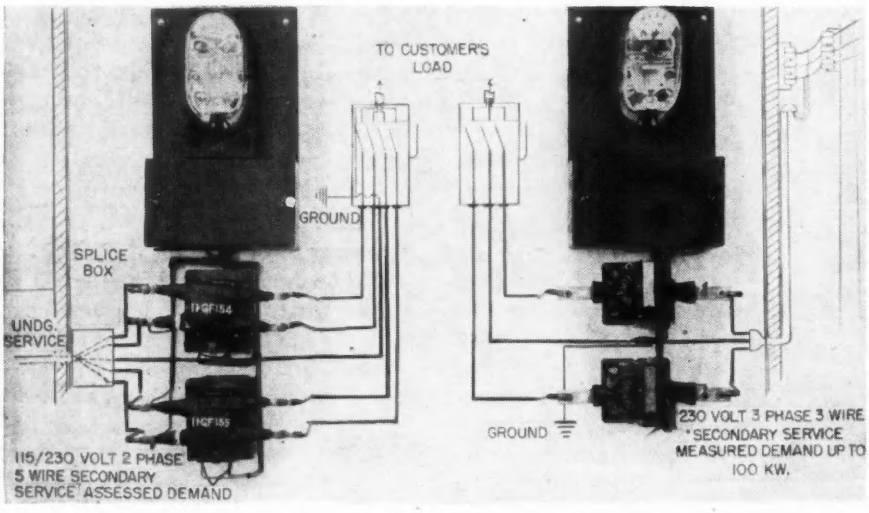
To bring about this understanding of metering practice and limitations among its sales engineers, the meter department of the Philadelphia company has reproduced the standard metering installations that it uses for rates commonly used. Sales engineers are asked to attend lectures on metering given by men conversant with both metering and rates. These lectures emphasize the factors that influence ability to meter a customer's service properly and economically. They also prescribe standards that will provide installations that are workable and accessible for testing and changing graphic demand charts.

At the conclusion of the course each sales engineer is given a set of photographs for his notebook, illustrating the various standard metering installations for each principal class of service. Caption material for each photograph relates it to the class of service and rate involved.

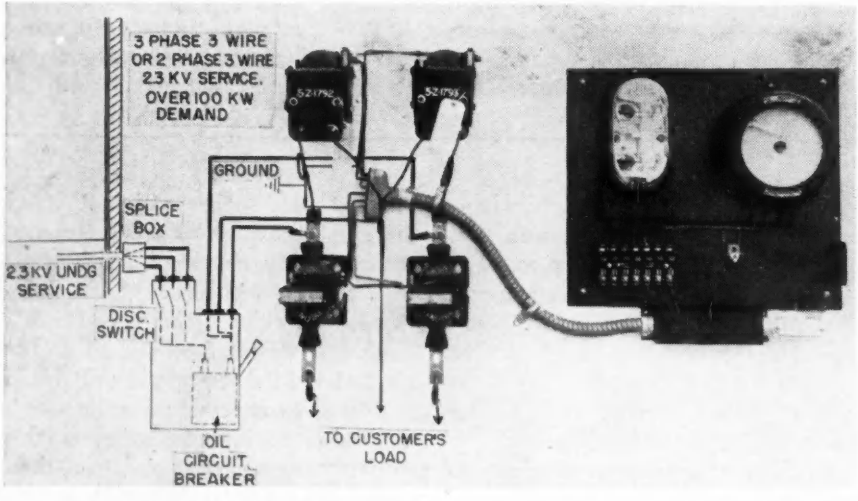
Photographs used in the course are shown in accompanying illustrations, first presented by the author before the Meter Committee of the Pennsylvania Electric Association.



SMALL COMMERCIAL AND INDUSTRIAL customers use self-contained meters on 230-v service. Maximum load allowable is limited to 20 kw demand. Rate is known as "general light and power"


TO CUSTOMER'S LOAD
GROUND
SPLICE BOX
UNDG. SERVICE
115/230 VOLT 2 PHASE 5 WIRE SECONDARY SERVICE ASSESSED DEMAND
GROUND
230 VOLT 3 PHASE 3 WIRE SECONDARY SERVICE MEASURED DEMAND UP TO 100 KW.

LARGE COMMERCIAL AND INDUSTRIAL metering for customers using secondary service and transformer-type polyphase meters for 3-phase, 3-wire or 2-phase, 5-wire 230-v installations. Maximum load available is limited to 100 kw

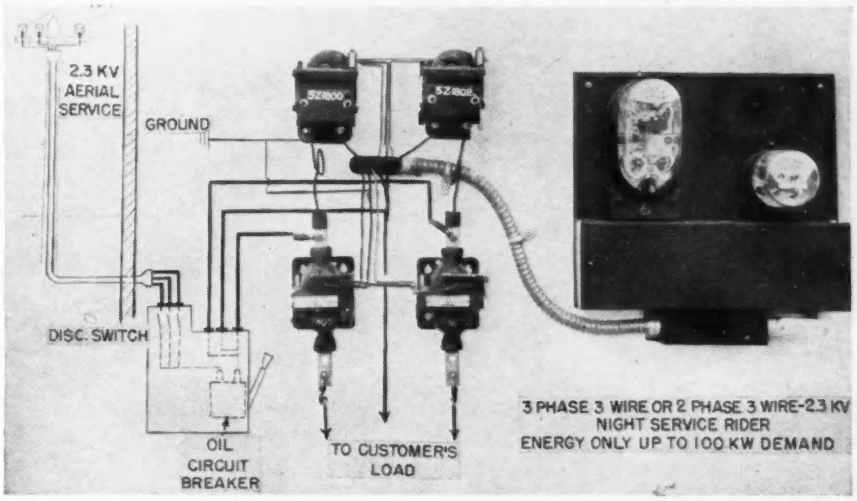

3 PHASE 3 WIRE OR 2 PHASE 3 WIRE 2.3 KV SERVICE, OVER 100 KW DEMAND
GROUND
SPLICE BOX
2.3KV UNDG SERVICE
DISC. SWITCH
OIL CIRCUIT BREAKER
TO CUSTOMER'S LOAD

TRANSFORMER-TYPE METERING for primary service using graphic demand metering for loads in excess of 100 kw. Service supplied for this type customer is either 3-phase, 3-wire or 2-phase, 3-wire. Same general arrangements is used for 13.2-kv and 33-kv service metered on the high-voltage side

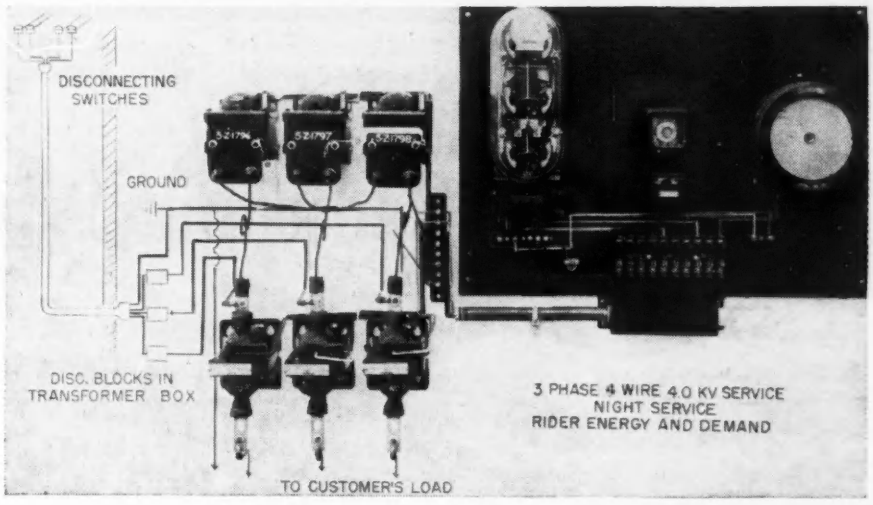
Meter Practice in Pictures

Sample installations of standard metering set-ups for rates in common use form basis for instruction to sales engineers on the relation between rates and electric metering practice

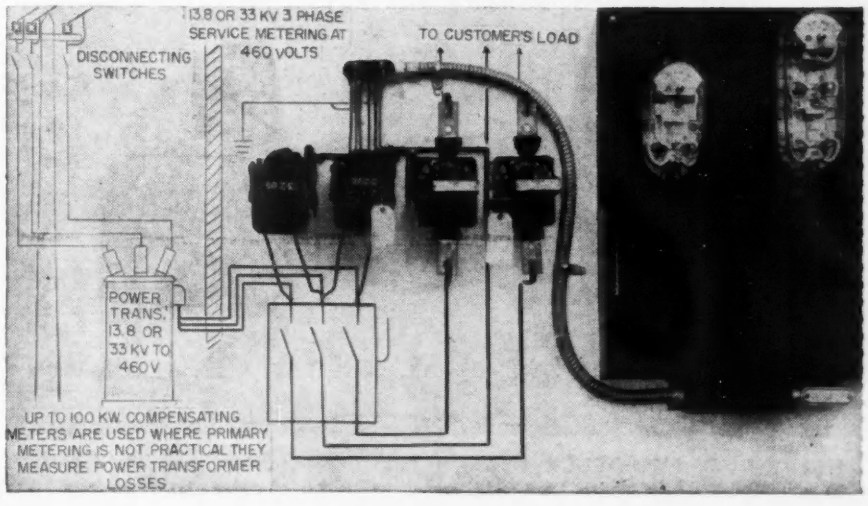
TRANSFORMER TYPE PRIMARY service with night service rider up to 100 kw for either 2-phase or 3-phase, 3-wire 2,300-v service uses this system. A 2-rate register and internal time switch are used on the meter. A cumulative demand meter measures maximum demand. The rate is "primary-distribution power, night service rider, energy only"



TRANSFORMER-TYPE METERING for primary service with night service rider, above 100 kw for 4-wire, 2,300/4,000-v service. A 2-rate register controlled by a separate time switch is used on the meter. A graphic meter measures the demand. The rate is known as "primary-distribution, night service rider, energy and demand"



HIGH-TENSION SERVICE is measured on the secondary side with a watthour meter and a compensating meter to record the energy loss in the transformer (Electrical World Feb. 25, 1933). Service is supplied either 13.2 or 33 kv, 3-phase 3-wire. Demands up to and including 100 kw are metered with cumulative demand registers and with graphic demand meters for loads in excess of 100 kw. More recently transformer loss compensators are used for loads up to 2,000 kw (Electrical World July 19, 1947). In this case meter panels are the same in size for comparable installations on the low-voltage side as for the last three installations pictured above. The rate applicable to this type of customer is known as "high-tension power"



TRANSMITTER-RECEIVER EQUIPPED TRUCK used on fall line of blocks in sagging-in by radio. 15-w FM transmitter (Link) operates on frequency of 153.59 mc. Communication radius of ten miles or greater insures high signal strength

Two-Way Radio Simplifies Sagging-In

HEAVY DUTY FWD TRUCK making a pull. Driver-operator is under constant instruction from radio car at other end of pull and from foreman wherever he may be, with time delay of only a few seconds in executing orders

FOREMAN GIVES RADIO ORDER to slack off and lower conductor to the ground for pressing on dead end clamp

TRUCK DRIVER ANSWERS loud speaker call to receive instructions from foreman who is two miles down the line

Procedure on Transmission Lines

Radio-telephone eliminates use of linemen for hand-signaling operations and makes possible instantaneous control. Radius of communication is ten miles or greater

TWO-WAY RADIO has supplanted arm signals for sagging-in transmission conductors on the Pacific Gas & Electric Co system. Practicability of this idea was first tried out with mobile transmitter-receiver service cars. It worked so well that equipment was purchased especially for the construction department. This is believed to be the first use of radio for stringing transmission lines. The accompanying photographs tell a pictorial story of the operation.

Three transmitter-receiver sets are used. One is placed in the truck that does the pulling. Another is in a car located at the point where the conductors are snubbed-in from the last pull. The third set is in the foreman's car. In this way communication is maintained between the three at all times and the entire operation is under perfect control.

There is not only a time saving in transmitting arm signals from end-to-end of the pull, but all lost motion is eliminated. Before using radio, it was customary to use twelve linemen in making the usual three-mile, 21-tower pull. These men were stationed on every other tower to transmit arm signals. Three linemen were required to sight-in for correct sag. With radio, only the three men for sighting-in are needed. This releases twelve linemen for other work.

It is claimed that the time required for making a three-mile pull has been reduced from 4 hr to 2 hr. Radio makes possible inching, prompt diagnosis of difficulties, quick resumption of pull after splicing, etc.

Radio equipment used is standard two-way FM with 15-w transmitters operating on a frequency of 153.59 mc furnished by the F. M. Link Co. PG & E's radio engineer, R. L. Brinton, finds that the radius of communication is usually ten miles or greater. This insures high signal strength for this on-the-job use.

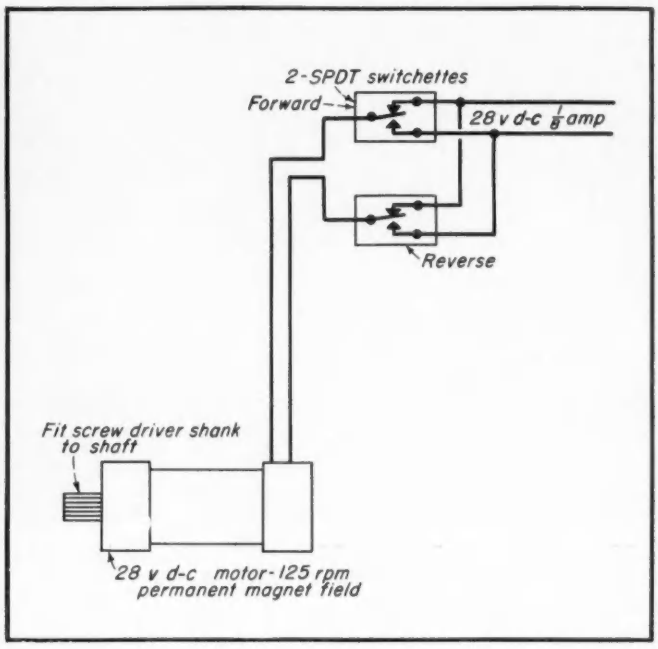
► Editor's note: The following is quoted from a letter from ELECTRICAL WORLD's West Coast editor—"Brinton and I were on our way out across the fields to take these pictures when we got hopelessly stuck in the mud two miles from the nearest help. Thanks to two-way radio in Brinton's car, the foreman soon rescued us."

HOW

DESIGN • CONSTRUCT • OPERATE • MAINTAIN

Electric Screw Driver

SMALL D-C MOTOR sets up or backs off instrument screws



CONNECTION DIAGRAM for electric screw driver

G. N. BURKHART
Assistant Chief Engineer
Duncan Electric Mfg. Co.

CURRENTLY APPEARING in various war surplus markets are small light weight d-c motors with permanent magnet fields and built-in speed reducers. A typical motor of this description is 1-⅜ in. diameter, 3-¼ in. long, weighs 6 ounces, operates on 27 v d-c, and has an output splined shaft with a speed of 125 rpm. By fitting a screw driver bit to the output shaft, and installing a pair of single-pole, double-throw Switchettes (GE Cat. No. CR1070C123) on the opposite end, a very handy electric screw driver may be assembled which is capable of delivering considerable torque and will operate in either direction. The d-c can be obtained from a small transformer and rectifier, also available in war surplus supplies.

This device is used in the Duncan plant to operate the various adjustment screws on watthour meters during the calibration process. Because of the "microset" feature of these adjustments, a screw driver of this type can be used here to considerable advantage. Other possible uses would be in removing registers for ratio check, and in tearing down meters on the repair bench.

• • •

Double Service by a Control Battery

AN EASTERN UTILITY saved at least 15 percent in initial cost, and gained operating economy in the following solution to a control battery problem. The original requirements were a 72-amp-hr control battery (8-hr discharge rate) and 125-v rating, plus a 64-v battery for starting a Diesel-electric unit. The generating unit was rated at 1,000 kw. It normally called for a 64-v battery with a capacity of 426-amp-hr at the 8-hr rate. This second battery would have handled an inrush of 2,800 amp and a steady current of 1,200 amp for 30 sec to meet all starting needs.

A resistance capable of cutting down the potential from 125 v to 64 v when in series with the starting motor across the control battery, was first considered. However, this would have wasted energy and called for a very large battery. Instead, the engine builder agreed to provide a 120-v starting motor. A 2-step starting contactor was provided with a low resistance in series with the starting motor for 0.75 sec. The second step automatically cut out nearly all the resistance except that needed for permanent adjustment. Step 1 eliminated the very high current inrush and started engine turnover. This now

air circuit breaker

FOR MAXIMUM PROTECTION AND OPERATING EFFICIENCIES

You'll find that this new Type AK-1 air circuit breaker for indoor and outdoor service on low-voltage circuits offers you more advantages than any other protective device...

IMPROVED ARC INTERRUPTION... less than one cycle ...decreases short circuit disturbances, means less strain on equipment and cables. Silver-alloy contact tips assure longer tip life, low resistance, and no oxidation or deterioration troubles.

MULTIPLE ARCING CONTACTS make possible—for the first time—a circuit breaker that has a short-time rating equal to its interrupting rating.

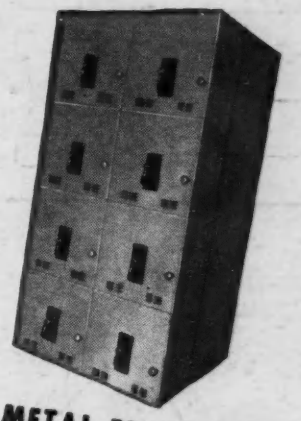
INTERCHANGEABLE TRIP UNITS are "sealed-in," operate in a non-sludging silicone fluid. You can easily install any AK-1 accessory in the field—auxiliary switch, solenoid closing mechanism and control, and shunt trip and undervoltage devices with terminal board. Access is from the front.

SELECTIVE TRIPPING on systems is possible because of adequate momentary rating and the new over-current trip devices. Faults are isolated; will not shut down a "selective system" by tripping the main breaker. Complete selectivity at all currents can be obtained with as many as four AK-s in series.

ALL-METAL BASE provides greater strength ... Dust-proof, dust-tight, weather-proof, explosion-proof, and water-tight enclosures are available.

YOU GET ADEQUATE "IC" (interrupting capacity) with the new AK-1 breaker for the protection of your production, equipment, and personnel.

Investigate further the many advantages of the Type AK-1 air circuit breaker by contacting your G-E sales representative. *Apparatus Department, General Electric Company, Schenectady 5, N. Y.*



METAL-ENCLOSED DRAWOUT UNITS

- SMALLER SPACE REQUIRED
- IMPROVED BUS CONSTRUCTION
- NEW RACK-OUT MECHANISM
- EASILY REMOVABLE BREAKERS
- ASK FOR BULLETIN GEA-4966

INDIVIDUAL BREAKERS

- ASK FOR BULLETIN GEA-4951

GENERAL ELECTRIC

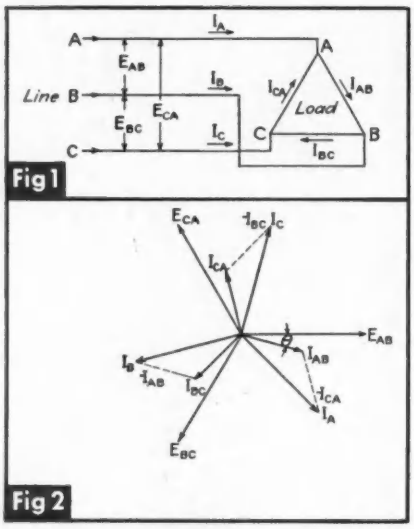
860-33

requires 525 amp, falling to about 460 amp at the end of Step 1. Step 2 closes with an 850-amp peak for 2 sec. Current then falls to about 250 amp and holds near this value until the engine fires regularly and the starting lever drops out.

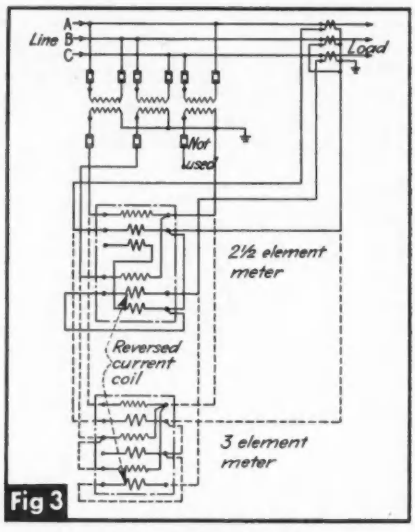
These lower current values enable a 125-v, 60-cell, 280-amp-hr Exide battery (8-hr discharge rate) to cover all requirements. These include the starting load for several engines, normal control bus duty, emergency lighting, etc. The battery is of the usual control bus type in glass jars. It is mounted in the control room near the engine.

The battery is floated in the usual manner on the control bus at 129 v. The unusual discharge output is promptly restored from a diverter-pole type motor-generator set floating continuously on the control bus. Operating experience has been most satisfactory over several months. Several engines have been started successively with appreciably less than the normal starting battery capacity available. The 15 percent saving is in the first cost for two batteries, plus the elimination of one charging equipment. The maintenance of one battery, together with its charging equipment and other components, was eliminated. Considerable station space was also saved.

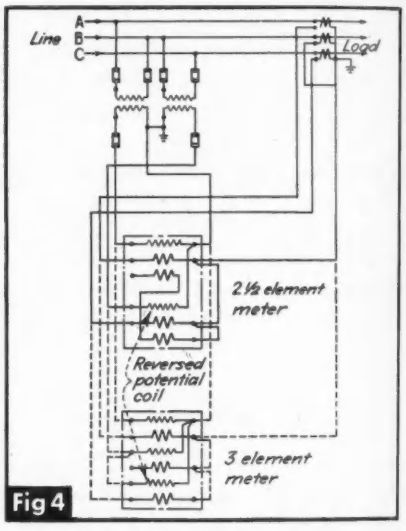
• • •



TYPICAL 3-PHASE, 3-wire ungrounded system with delta-connected load



POTENTIAL TRANSFORMERS are all delta-wye connected



POTENTIAL transformer connections are reversed when connected open delta

Delta-Wye Conversion Brings Metering Problem

R. LAMBERT
Switchgear Engineer
Allis-Chalmers Mfg Co
Milwaukee, Wis.

IN CHANGING OVER from a delta to a wye-connected system, one of the problems most often encountered is that of polyphase metering. This is particularly true when 2-element meters have been used. Since these cannot be adapted to 3-phase, 4-wire systems, considerable time and money can be saved by using 2½- or 3-element meters.

The accompanying diagrams illustrate methods of connecting either 2½- or 3-element wattmeters or watthour meters to a 3-phase, 3-wire ungrounded system. The conversion connections to a 4-wire system have been omitted as they are standard connections normally used.

Fig. 1 shows a typical 3-phase, 3-wire ungrounded system with delta load. The proof for a wye load can be similarly shown. Assuming balanced conditions with a power factor $\cos\theta$, the power delivered to the load is given by equation (1). Fig. 2 is the vector diagram showing current and voltage relationships represented by Fig 1 and the assumed conditions. The development of equations (1) to (8) follows readily. Equation (7) indicates that the total power can be measured by using two line-to-line voltages and two line-currents. The negative sign preceding the second term indicates that it is necessary to reverse the polarity of either the voltage or the current to obtain proper indication. This is illustrated by

EQUATION TABLE

$$W = E_{ab}I_{ab}\cos\theta + E_{bc}I_{bc}\cos\theta + E_{ca}I_{ca}\cos\theta \quad (1)$$

$$\frac{W}{\cos\theta} = E_{ab}I_{ab} + E_{bc}I_{bc} + E_{ca}I_{ca} \quad (2)$$

$$I_a = I_{ab} - I_{ca};\ I_{ab} = I_a + I_{ca} \quad (3)$$

$$I_c = I_{ca} - I_{bc};\ I_{bc} = I_{ca} - I_c \quad (4)$$

$$\frac{W}{\cos\theta} = E_{ab}(I_a + I_{ca}) + E_{bc}(I_{ca} - I_c) + E_{ca}I_{ca} \quad (5)$$

$$= E_{ab}I_a - E_{bc}I_c + (E_{ab} + E_{bc} + E_{ca})I_{ca} \quad (6)$$

$$= E_{ab}I_a - E_{bc}I_c \quad (7)$$

$$= E_{ab}I_a + (-E_{bc})I_c \text{ or } E_{ab}I_a + E_{bc}(-I_c) \quad (8)$$

Getting Load and Voltage Facts IN A HURRY!

TYPE AK-1 HOOK-ON VOLT-AMMETER

To keep plant operation at peak efficiency and spot trouble before it causes costly breakdowns, constant testing with reliable instruments is a "must." Here you'll find the General Electric hook-on volt-ammeter one of the handiest and most versatile instruments you've ever used, for it permits quick measurement of both volts and amps.

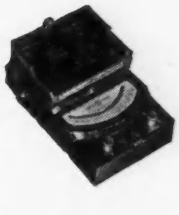
6 INSTRUMENTS IN ONE

The reason the AK-1 hook-on volt-ammeter is so handy is that it's really six instruments in one. It has six ranges: 0-15/60/150/600 amp and 0-150/600 volts (for a-c circuits only). To measure amperes, all you do is hook it around a conductor, flick the selector switch to AMPERES, and there's your measurement—no cutting of conductors, no lost service. To measure volts, all you do is connect the voltage leads, snap the switch to VOLTS, and take the reading—no extra equipment needed.

Extension poles, in four- and six-foot lengths, are available for using the AK-1 on high-voltage circuits, and for reaching into inaccessible places. Also, a cowhide leather carrying case can be obtained for protecting the instrument when it is not in use. For further information, contact your local distributor or your nearest G-E sales office. Write for Bulletin GEA-2950, *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

Which of these Testing Instruments do you lack?

AF-1 A-C LOAD VISUALIZER



AP-9 A-C VOLT-METERS and AMMETERS

CF INKLESS RECORDER

GAUSS METER

GENERAL ELECTRIC

equation (8) in the accompanying table.

Thus, it becomes a simple problem to connect any 2½- or 3-element wattmeter or watthour meter to a 3-phase, 3-wire ungrounded system. Fig 3 illustrates this connection using instrument transformers. The potential transformers are shown connected delta-wye as this requires less change when converting to the 4-wire system. It is to be noted that both the 2½- and 3-element meters have been shown with internally connected potential coils on the common side. This dictates that the current be reversed as required by equation (8). When using the open-delta potential transformer connection shown in Fig 4 the voltage polarity must be reversed. When all connections are brought out to studs, either the voltage or current may be reversed, but not both. In all cases the primary of the potential transformer must be operated at rated voltage, thus producing rated 120 volts on each secondary winding. When using a 3-element watthour meter, it is necessary to energize the unused potential element to prevent drag on the meter. If instrument transformers are not used, the same connections will apply. Care must be taken in applying the proper polarities.

Fig 4 illustrates connections using potential transformers connected open-delta. This application may be particularly useful where no spare 2-element meters are available for an existing 3-wire installation and it is desirable to substitute 2½- or 3-element meters in the installation.

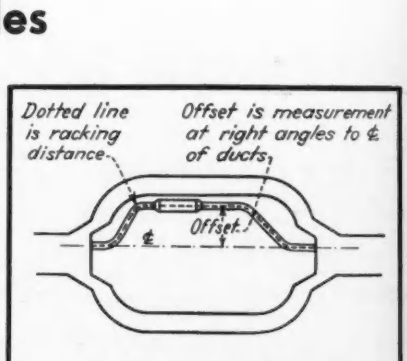
In using these connections, the principal requisites are that (a) rated voltage be applied to the potential coils; (b) that the voltage be paired with the proper current as indicated in equation (8); and (c) that the proper polarity be observed as indicated in equation (8).

The accuracy obtained from any of the above connections is comparable with the accuracy obtained using any similar 2-element meter. As long as the instrument transformer ratios are not changed, the meter multipliers, if any, or scales, are not affected by the conversion. The changeover can be made with a minimum of time and expense and none of the meters or instrument transformers will need to be replaced.

• • •

Racking Cable in Manholes

Preliminary to jointing, the training and racking of cables in manholes is essential. Considerable experience has been obtained by an eastern utility with the movement of cables under cyclic load conditions. As a result, certain racking and training practice has been established. This is shown in the accompanying diagram and table. For a 3-conductor, 500,000-cir mil, 15-kv, paper and lead cable, the specifications call for not less than 11 ft of cable with an offset of at least 18 in. The minimum bending radius is ten times the cable diameter, or approximately 23 in. The company has found that these conditions can be obtained in an 8-ft x 5-ft manhole by dropping the joint 9 in. below the duct level. Bellows are required when either the racking distance or the offset is less than the minimum shown in the accompanying table.

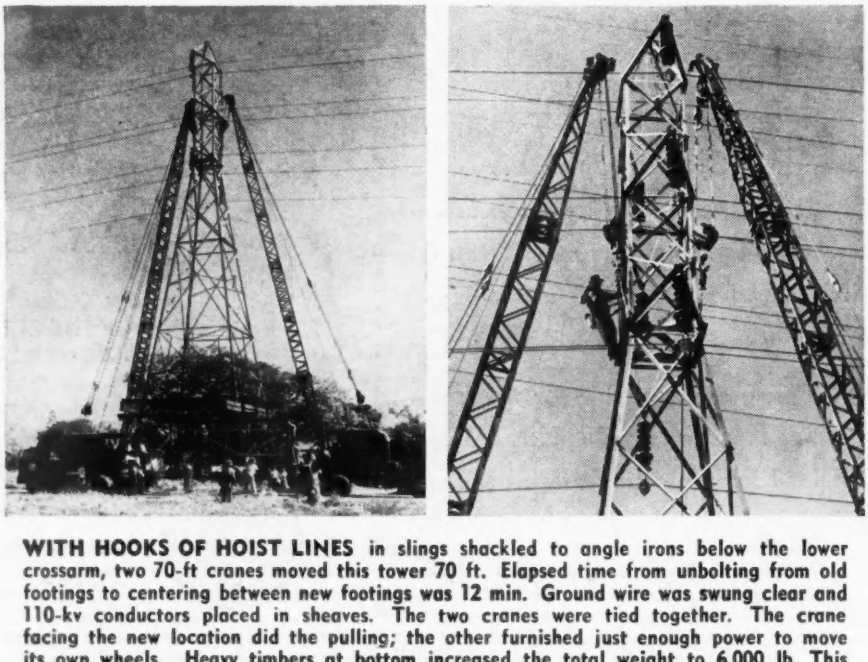


MULTI-CONDUCTOR POWER CABLE

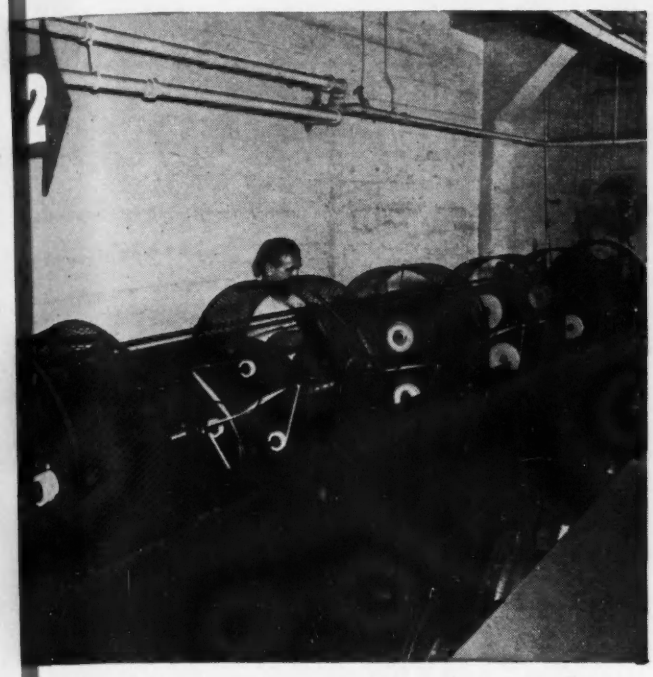
Cable size	Minimum cable racking distance (Feet)	Minimum cable offset (Inches)
3x⅛ & ⅙	9	14
3x300&350Mcm	10	16
3x400&500Mcm	11	18
3x700Mcm &2x1,000 Mcm &2x1,500Mcm	12	20

RACKING DISTANCES and offsets for multiconductor cables

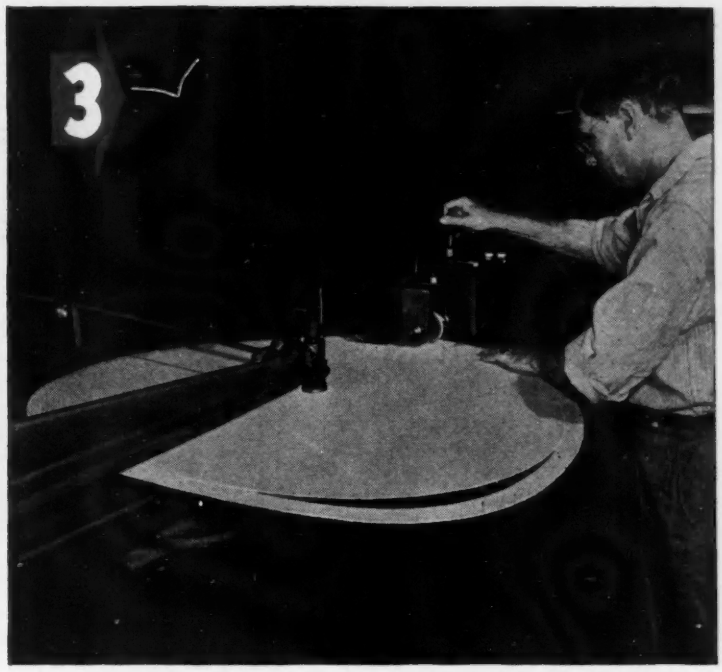
Cranes Lift And Move Tower



WITH HOOKS OF HOIST LINES in slings shackled to angle irons below the lower crossarm, two 70-ft cranes moved this tower 70 ft. Elapsed time from unbolting from old footings to centering between new footings was 12 min. Ground wire was swung clear and 110-kv conductors placed in sheaves. The two cranes were tied together. The crane facing the new location did the pulling; the other furnished just enough power to move its own wheels. Heavy timbers at bottom increased the total weight to 6,000 lb. This stabilized the tower. Job was planned and executed by Alfio Bissiri, electrical engineer, and J. A. Joyce, general superintendent of transmission, Los Angeles Department of Water & Power, Los Angeles, California

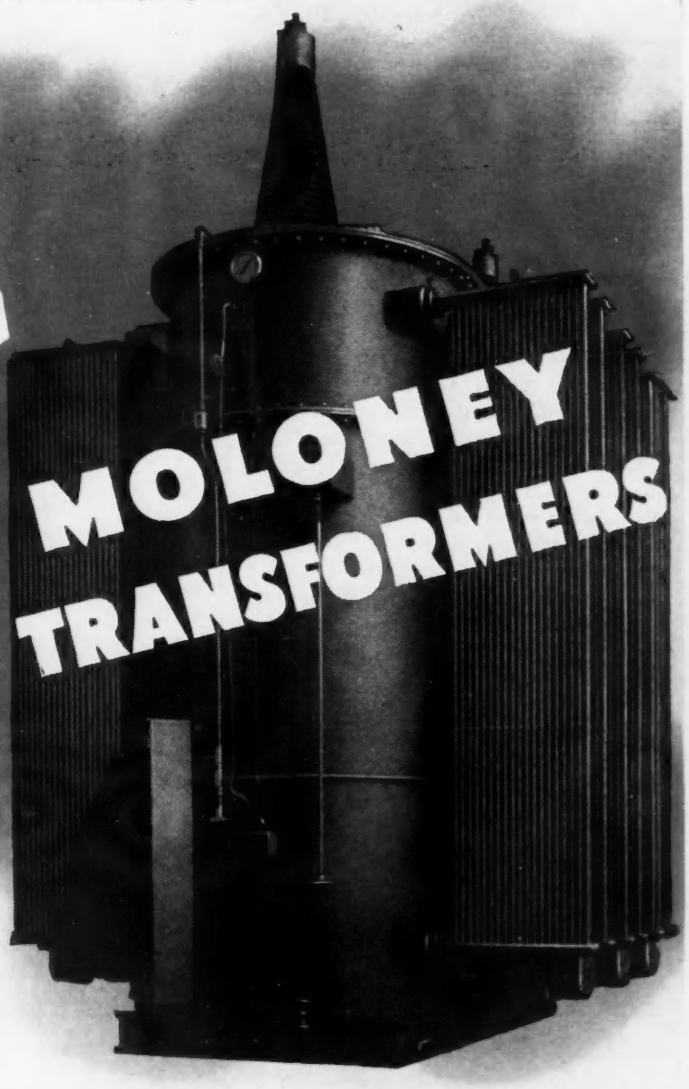


iderable special equipment is required to produce a transformer will withstand surges and overloads imposed in actual service. ng the special machines Moloney uses in the fabrication of trans- er windings, is the conductor insulating machine pictured above. conductors used in coils located at the line end of the winding of voltage transformers, are provided with extra insulation to help tand voltage surges incident to lightning strokes and switching tions. This machine is used to provide the extra layers of cable insulation required.



Another special machine is that for cutting pressboard insulation for various applications. In the winding department, this machine is used for cutting pressboard collars which are used for insulation between adjacent sections of multi-turn disc coils where the conductor insulation itself is not sufficient for this purpose. The pressboard used in this and other applications, is made especially for insulating purposes and is of the finest quality obtainable.

oils at the line end of the winding take the brunt of any surge that the transformer and are frequently referred to as "buffer" coils. are of special design to withstand effects of lightning and switching . Conductors are machine wrapped with extra layers of cable paper vide greater than normal insulation between turns. Photo shows insulation being applied to the coils in the form of multiple layers ulating tape. Proper application of the tape is important to obtain rm insulation and adequate resistance to the effects of surges.



ECTRIC COMPANY

CTORIES AT ST. LOUIS, MISSOURI AND TORONTO, ONTARIO, CANADA

Comparative Properties of Grounding Electrodes

Adapted from a study made for the Thomas & Betts Co, Elizabeth, N. J. by Professor Reinhold Rudenberg, Harvard University

Data provide a comparison of various types of ground electrodes with respect to electrical, geometrical and thermal qualities during operation

RESISTIVITY of the ground is taken as $\rho = 10^2$ ohm-meter, an average value for moist soil. For dry soil the resistance would be about 10 times higher, the voltage gradient hazard 10 times greater; heating of the soil would be effected 10 times faster.

In order to provide for a good comparison of their properties, all ground electrodes considered here are so dimensioned that they give approximately the same ground resistance. In some instances the wall thickness had to be chosen arbitrarily. Current carrying capacity is based on a uniform current density which for matter of comparison is taken as 100 amp per square meter and this corresponds to 60 C rise in 100 sec.

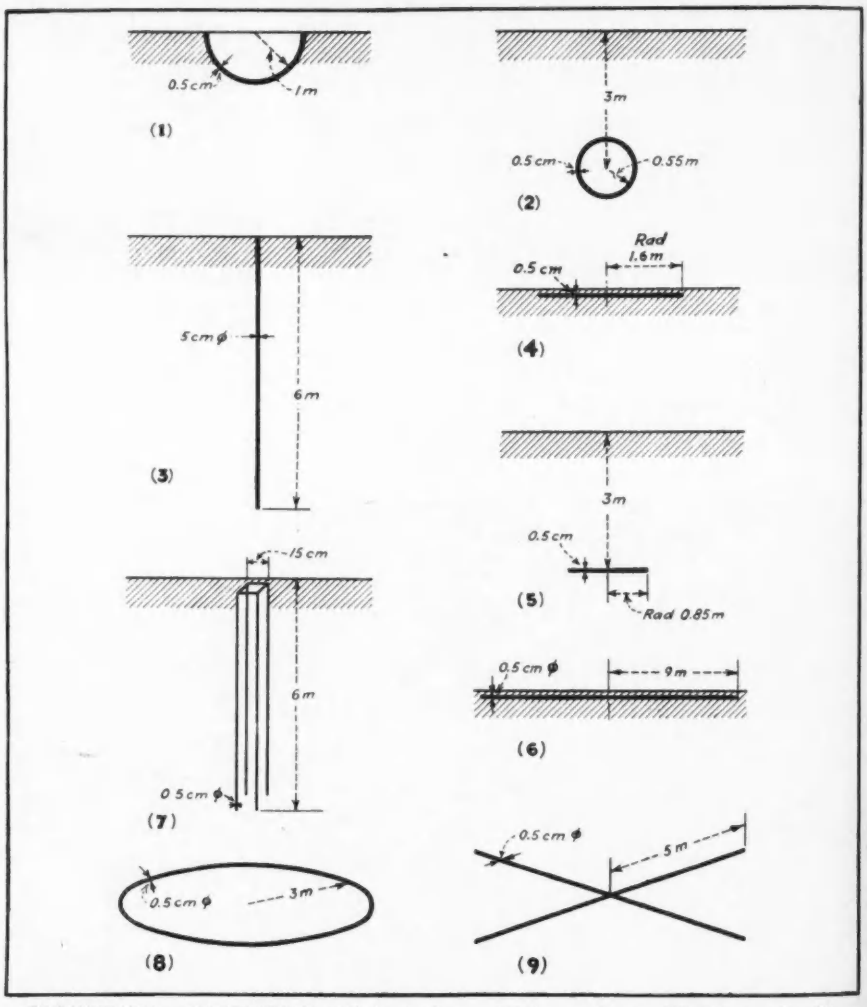
Maximum voltage gradient determines the hazard to men and animals at the earth's surface.

Concentration of current at edge of electrode (or edge effect) causes local heating and possible drying out of soil.

As for driven rods and deeply placed disks of equal ground resistance the rods have the advantage with respect to corrosion, but the disks have the advantage in current carrying capacity. The latter advantage is important at times of heavy ground fault current. Still higher currents could be carried by equivalent hemispheres or disks at the surface of the earth but this advantage would be lost in winter due to the increased resistance of frozen soil.

Deep-disk and deep-sphere electrodes have low electrical gradient at the surface of the earth. Current concentration at edge of disk, whether on the surface or placed deep, is smaller than at the tip of a rod. For a deep disk placed below pole or tower, the upper and lower surfaces have different resistances to ground; any increase in size to compensate for this loss will, however, increase the current carrying capacity.

Long wires or strips, in whatever form, are very favorable with regard to minimized volume of material needed, but they are limited as to permissible amount of ground fault current.



GROUNDING ELECTRODES: (1)-hemisphere; (2)-deep sphere; (3)-driven rod; (4)-surface disk; (5)-deep disk; (6)-shallow buried wire; (7)-parallel wires; (8)-wire ring; (9)-star

COMPARISON OF GROUNDING ELECTRODES

Item	Unit	Electrode Type and Fig No.					
		Hemisphere (1)	Deep Sphere (2)	Driven Rod (3)	Surface Disk (4)	Deep Disk (5)	Wires or Strips (6)–(9)
Ground resistance	ohms	16	15.9	16.3	15.7	16.2	16
Surface	square meters	6.28	3.80	0.94	8.02	4.54	0.14
Volume	cubic decimeters	31.4	19.0	11.8	40	11.4	0.36
Current carrying capacity	amp	628	380	94	800	454	14
Hazardous voltage gradient	.....	Low	Very low	High	High	Very low	Very high
Edge effect	.....	Nil	Nil	High	Low	Low	Very high

JOSLYN

LUBEX CLAMPS and CLIPS

Guy Clamps depend on pressure for their holding power. Greater pressure means more holding power. Joslyn LUBEX guy clamps and Tubase clips have greater holding power because with nuts treated by the LUBEX process, it is possible to develop greater pressure on the clamp using the same amount of wrench torque. This is true for any kind of clamping device but especially true in the case of a standard guy clamp where the holding power depends on pressure alone and is not assisted by snubbing action as in the case of Tubase clips. LUBEX treated nuts develop double the bolt tension for any given wrench torque and make it possible to utilize the great strength of Joslyn heat treated clamp bolts.

Extensive test information is available for the asking. This information is made up in a different form which users will find useful in determining guying specifications.

Write for your copy of Joslyn Test Information on Clamps and Clips

Sales offices in principal cities

THE JOSLYN CO.
THE SOUTH EAST-JOSLYN CO.
SOUTHERN JOSLYN CO.
JOSLYN SOUTHWEST CO.
JOSLYN PACIFIC CO.

JOSLYN MFG. AND SUPPLY CO.

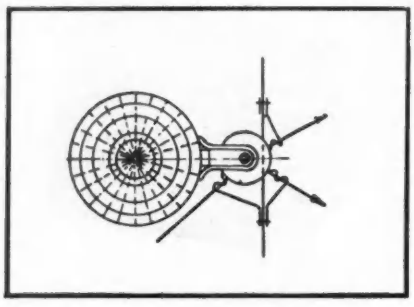
Complete Pole Line Equipment

30 NORTH WACKER DRIVE, CHICAGO 6, ILL.

A Guide for Service Attachments At Poles and Buildings

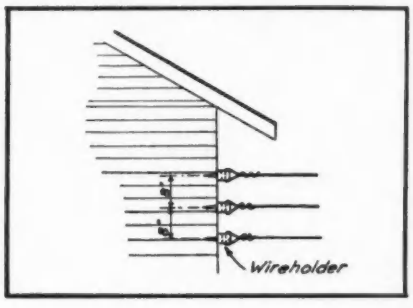
An adaptation from urban and rural construction standards of Tennessee Valley Power Distributors' Association, Chattanooga, Tenn.

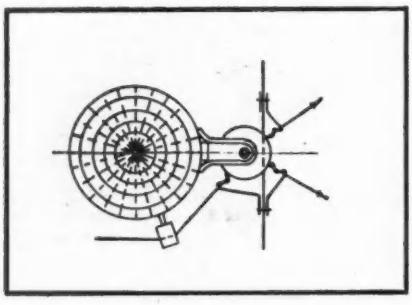
POLE ATTACHMENTS | **BUILDING ATTACHMENTS**



ATTACH service direct to rack spool

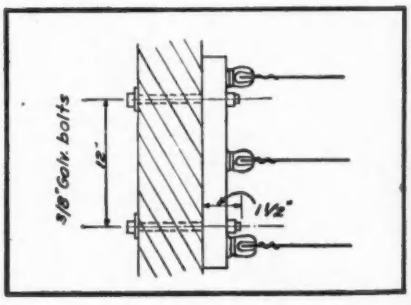
FOR SERVICES NO. 4 and smaller to frame building construction

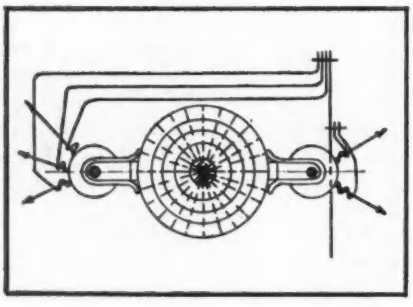




THREAD services No. 4 and smaller through wireholder to avoid chafing, or as shown in illustration below

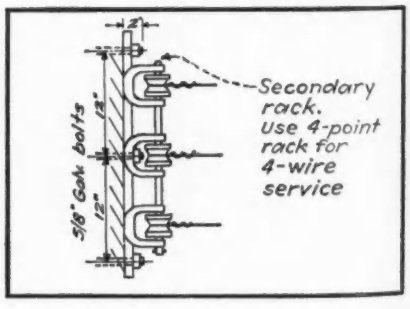
FOR SERVICES NO. 4 and smaller to buildings other than frame construction





USE second rack only: (1) Where more than two field side services require stand-off insulators; (2) Where rack spool is crowded; (3) Where a field side service is larger than No 4 conductor

For service conductors No. 2 to 4/0



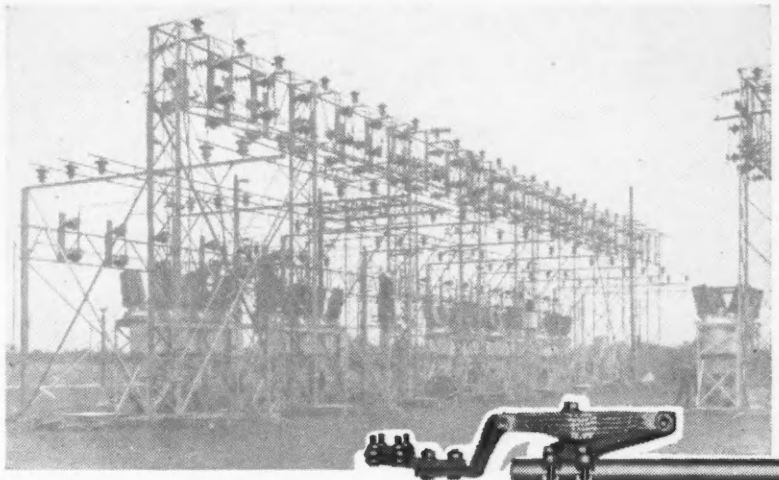
NOTES

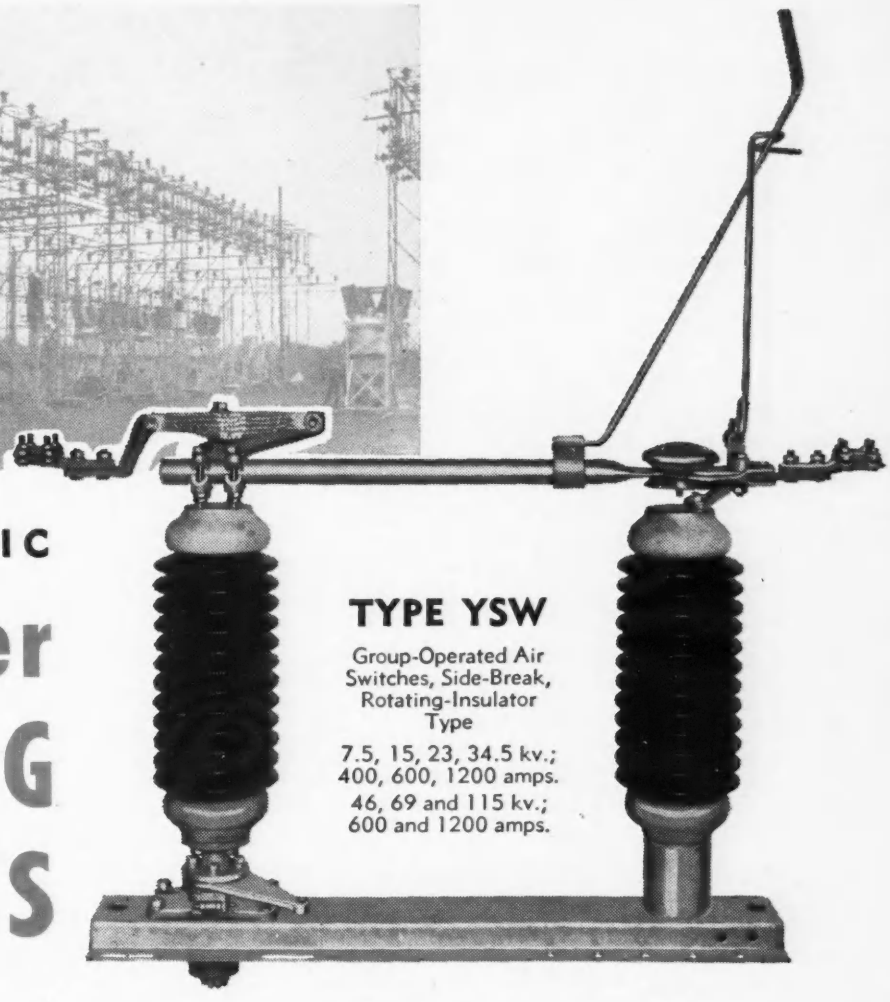
Service shall be as slack as conditions will permit.

Building attachments shall be vertical, if possible.

At point where service attaches building, clearance to ground line shall be a minimum of 10 ft and a maximum of 30 ft except where otherwise specified.

Attachment for services larger than 4/0 to be specified on job plan.





PACIFIC ELECTRIC

Solid Silver ROLLING CONTACTS

assure

TYPE YSW

Group-Operated Air Switches, Side-Break, Rotating-Insulator Type

7.5, 15, 23, 34.5 kv.; 400, 600, 1200 amps.

46, 69 and 115 kv.; 600 and 1200 amps.

Easy Switch Operation all year 'round

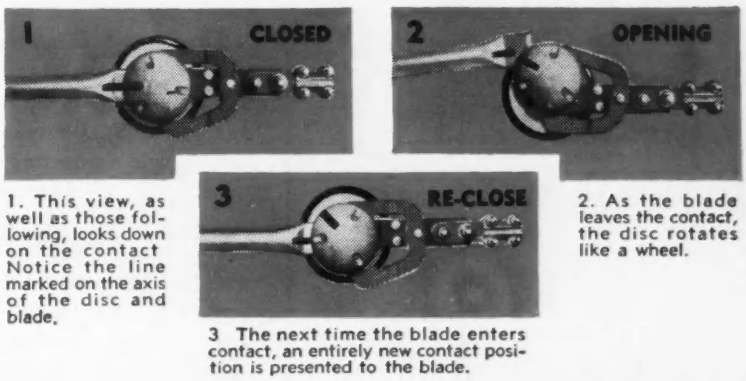
Rolling-Disc Contacts using high unit pressures assure good contact and easy operation. No flexible jumpers are used on these contacts. No current carried by pins or bolts. Solid Silver Inserts maintain current-carrying ability.

Above insulator caps, the parts are nonferrous. The ferrous parts below are double hot-dipped galvanized.

Rotating Insulators have anti-friction, widely-spaced ball bearings with weather shields.

The switch is light in weight, of simple design and well known for its low maintenance. Insulators of N.E.M.A. Standard. It is easily installed, no further adjustments necessary. Get all facts on the YSW Switch, its reliability and its easy operation the year 'round.

How the Exclusive Rolling Contacts Reduce Friction, "Run" Cooler, and Assure Easier Operation



1. This view, as well as those following, looks down on the contact Notice the line marked on the axis of the disc and blade.

2. As the blade leaves the contact, the disc rotates like a wheel.

3 The next time the blade enters contact, an entirely new contact position is presented to the blade.

PACIFIC ELECTRIC MFG. CORPORATION

5815 THIRD STREET, SAN FRANCISCO 24, CALIFORNIA • P. O. BOX 419, GARY, INDIANA

C. H. CUTTER 814 Securities Bldg. Seattle 1, Wash.	**G. B. KIRKWOOD** 437 S. Hill St. Los Angeles 13, Calif.	**J. E. REDMOND CO.** 400 W. Madison St. Phoenix, Ariz.	**KRIPPNER AND POLLEY** 1 Downing St. Denver 9, Colo.	**PIERCE G. FREDERICKS** 90 West St. New York 6, N. Y.
A. A. MARRS 526 Dwight Bldg. Kansas City 6, Mo.	**C. C. MUSGROVE** 508 Southland Life Annex Dallas 1, Texas	**ARKANSAS ELECTRIC CO.** 316 Louisiana St. Little Rock, Ark.	**EDGAR F. HUBERT CO.** 936 Statler Bldg. Boston, Mass.	**WILLIAMSON & WILMER, INC.** 617 Mutual Bldg. Richmond 19, Va.

Other Representatives in Principal Cities

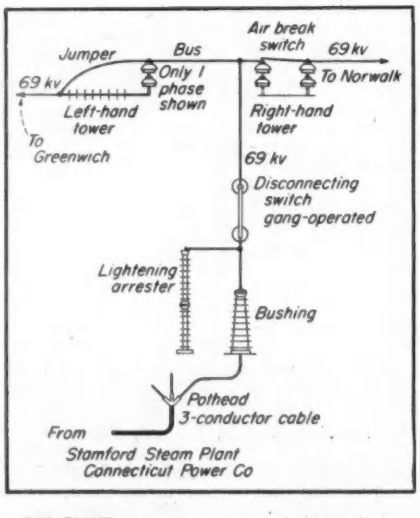
Symmetrical Design for Junction Tower

Only two steel towers were used in a sectionalizing junction at Stamford, Ct., when tying two utility systems together. Here two 69-kv underground oil-filled cables from the Stamford steam plant of the Connecticut Power Co connect with the Connecticut Light & Power Company's line that runs between Greenwich and Norwalk.

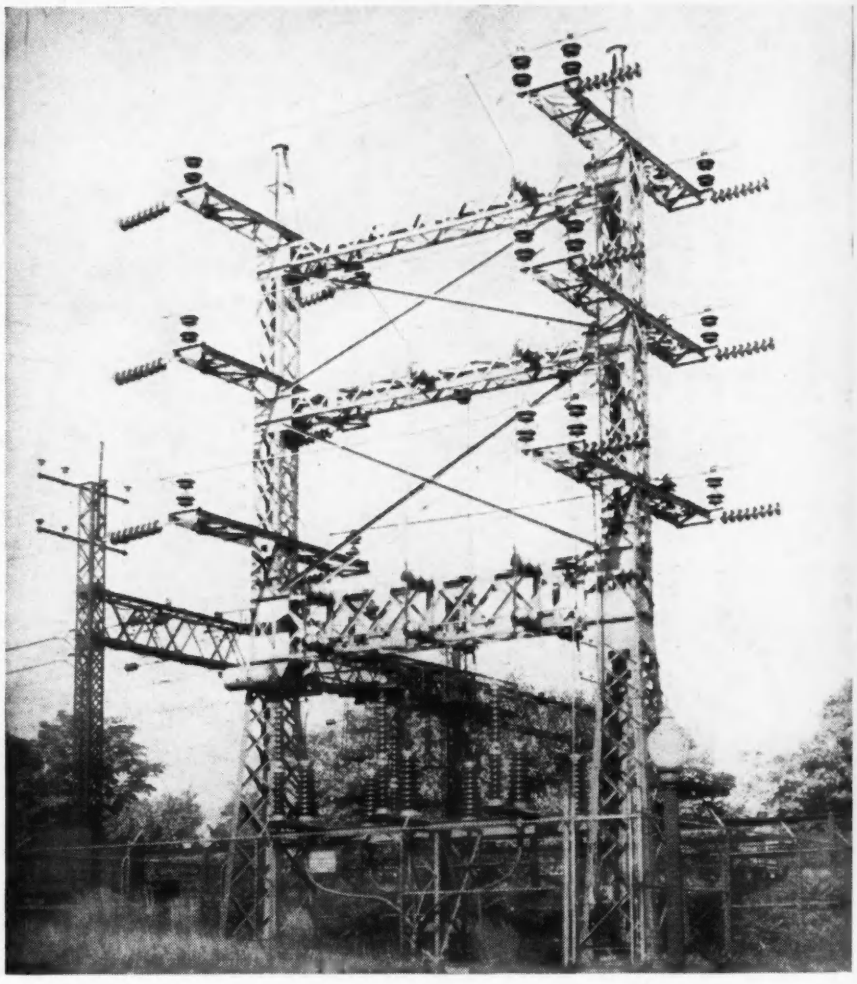
For this installation, the towers are located beside the New Haven Railroad in a reserved area close by the passenger station. The towers are each 52 ft high. The open wire line is provided with No. 4/0 conductors. Laterally, the structure measures about 24 ft wide and is completely enclosed by fencing.

Disconnecting Switches

One circuit is carried on one side of the towers and the other on opposite side. Disconnecting switches of the air break type are mounted on insulators supported by the structural steel members on each side of the right-hand tower. The cables from the steam plant terminate in potheads near the ground level on opposite sides of the towers. From these the phase wires are carried upward through bushings to gang-operated disconnects from which taps are carried to the horizontal open wire runs or buses from tower to tower. Lightning arrester taps are made just above the pothead terminals.



CIRCUIT connections as indicated by single-phase diagram. Installation has two 3-phase circuits for both underground and overhead lines



STEEL TOWERS with cross members provide sectionalizing facilities for double-circuit 69-kv line with cable connections to nearby steam plant

The design illustrates the rugged construction that is desirable for a junction tower set-up for operating at this potential. It emphasizes the value of complete symmetry of layout as a contribution to operating safety. On the site there is no reasonable excuse for failing to identify each phase and disconnecting switch at all times. The spacing provided between the two circuits and also between phases of each circuit permits maximum convenience in installation, testing and maintenance. The entire structure is protected by wire fencing and has no connection with the electrified railroad circuits shown in the background on separate tower and bridge installation.

Circuit connections are shown in the diagram.

Inflated Dumbbell for Testing Pipe Welds

G. L. RHODES
System Planning Engineer
New Orleans Public Service Inc
New Orleans, La.

A HOME-MADE "DUMBBELL" device provided New Orleans Public Service Inc with a quick and easy way of testing bell-hole welds in the pipe casing of their new 110-kv oil-pipe cable installation. With it, welds could be tested at 500 psi pressure, above or below ground, without putting the entire pipe section under pressure.

Cylindrical ends of the dumbbell shown have rubber walls and are

No Hill Too Steep

. . . and, we hasten to add—*no mud too deep, no going too rough and rugged.*

Unlike conventional-type trucks, Marmon-Herrington *All-Wheel-Drives* have live power and traction in *all wheels.* With front wheels pulling, rear wheels pushing, they are built to carry peak pay-loads—where you want them, when you want them—in all weather, under all operating conditions . . . on the highway—*or off.*

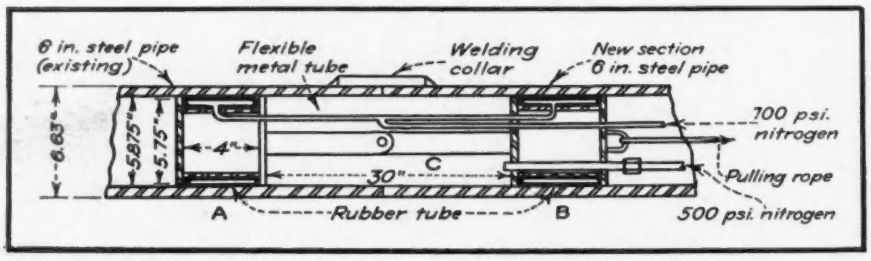
If that's the kind of superlative all-year, all-weather performance you want in your trucks, you will find it in Marmon-Herrington *All-Wheel-Drives.* These spectacular trucks begin where others sit down and quit—swiftly, easily, they conquer deep mud, sand or snow, steep hills and mountain grades—*under full load.*

Let your Marmon-Herrington dealer show you these great new trucks—both regular Marmon-Herrington models and *All-Wheel-Drive* converted Fords. He'll give you an on-the-job demonstration of performance-ability you never thought possible in motor trucks.

MARMON-HERRINGTON COMPANY, INC., INDIANAPOLIS 7, IND.

MARMON-HERRINGTON

All·Wheel·Drive



WELDED JOINT pressure testing cell developed by New Orleans Public Service

connected by a metal hose. This metal hose is connected to a rubber hose fed down the pipe from an external nitrogen bottle under 700 psi pressure. The dumbbell is centered at a weld by inserting each half into the open pipes before welding is begun.

To test the weld, nitrogen at 700 psi is introduced into the rubber walled cylinders. The walls bulge, effectively blocking the pipe on either side of the weld. Nitrogen under 500 psi pressure can then be introduced into the space between the cylinders by means of another rubber hose fed down the pipe, to make the test.

When the test is completed, walls of the cylinders are collapsed and the dumbbell pulled back through the pipe section by a line connected to pulling eyes that are located in the cylinder end.

DEVICE for pressure-testing the bell-hole pipe welds without pumping up entire length of pipe. Unit was developed when installing 110 kv oil-pipe cable in New Orleans

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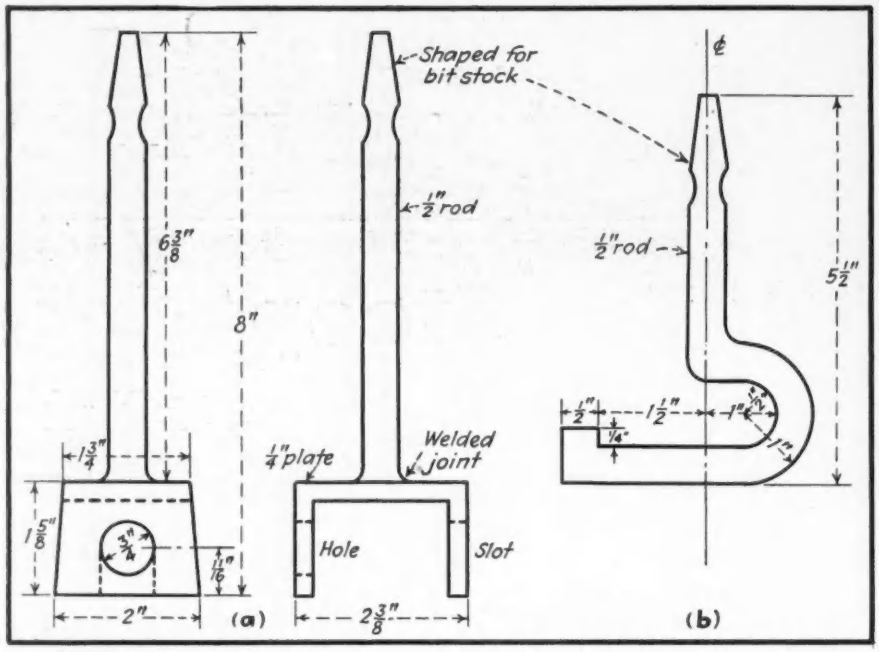
Speed Wrenches Handle House Brackets



WRENCH OUTLINES: (a) for use with metal tee bracket and (b) to fit typical porcelain service bracket

To facilitate installing and removing service brackets on houses, speed wrenches as illustrated were designed by Arthur J. Cahill, Amesbury (Mass.) Electric Light Co. This utility is a subsidiary of the New England Electric System.

Each wrench is designed to receive a bit stock, and is of ½ in. rod, shaped to handle (a) metal tee bracket, and (b) any typical porcelain service bracket. Being 8 in. and 5½ in. long respectively, the wrenches are light to handle and compact for use in varied locations.

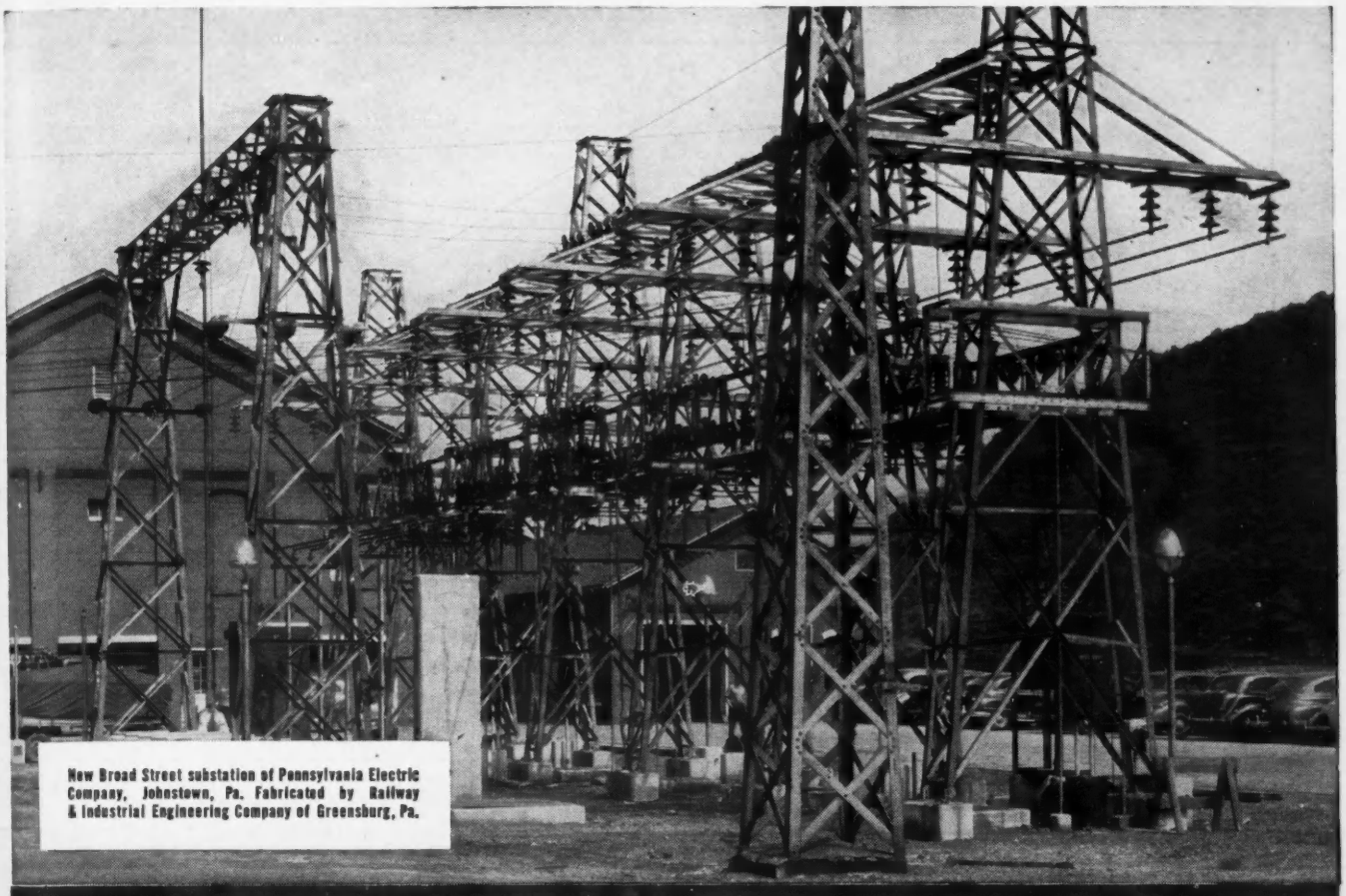
It has been found that considerable savings in time and money result from the use of these specially-designed wrenches when removing or installing house brackets.

TRANSFORMER TAGS are included with customary pole identification markers by Southern California Edison Co on all transformer poles. The plate is a duplicate of that on the transformer. Nails, stamped with height of pole and year set, are also included

Tests of Conductor Ties

R. E. JONES
Assistant Engineer
Hydro-Electric Power Comm. of Ont.
Toronto, Canada

Tabulated findings are compiled from investigations on holding power and on causes of failure of conductor ties on pin insulators.



New Broad Street substation of Pennsylvania Electric Company, Johnstown, Pa. Fabricated by Railway & Industrial Engineering Company of Greensburg, Pa.

ALL-ALUMINUM SUBSTATIONS

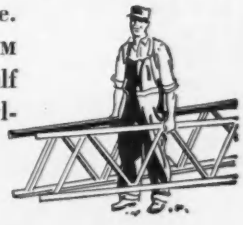
cut erection time 75%, maintenance cost to zero

In only 14 working hours, a 5-man inexperienced crew working without a crane, erected the strong, lightweight Alcoa Aluminum supporting members of this all-aluminum substation. It would have taken at least a week to 10 days' time, and a crane, to erect a similar structure built of ordinary heavy metal.

And there will be no periodic shutdowns of the electrical circuits in order to paint the structure. Aluminum cannot rust, needs no paint or protection even in industrial atmospheres.

Alcoa Aluminum Tubular Bus make up the electrical circuits of this substation. They're a special electrical grade of aluminum that gives high current-carrying efficiency. You have your choice of Alcoa Aluminum Bus Conductors in many sizes, and four shapes . . . tubular, channels, angles, and flat bars. There are Alcoa Aluminum Fittings for each size and shape.

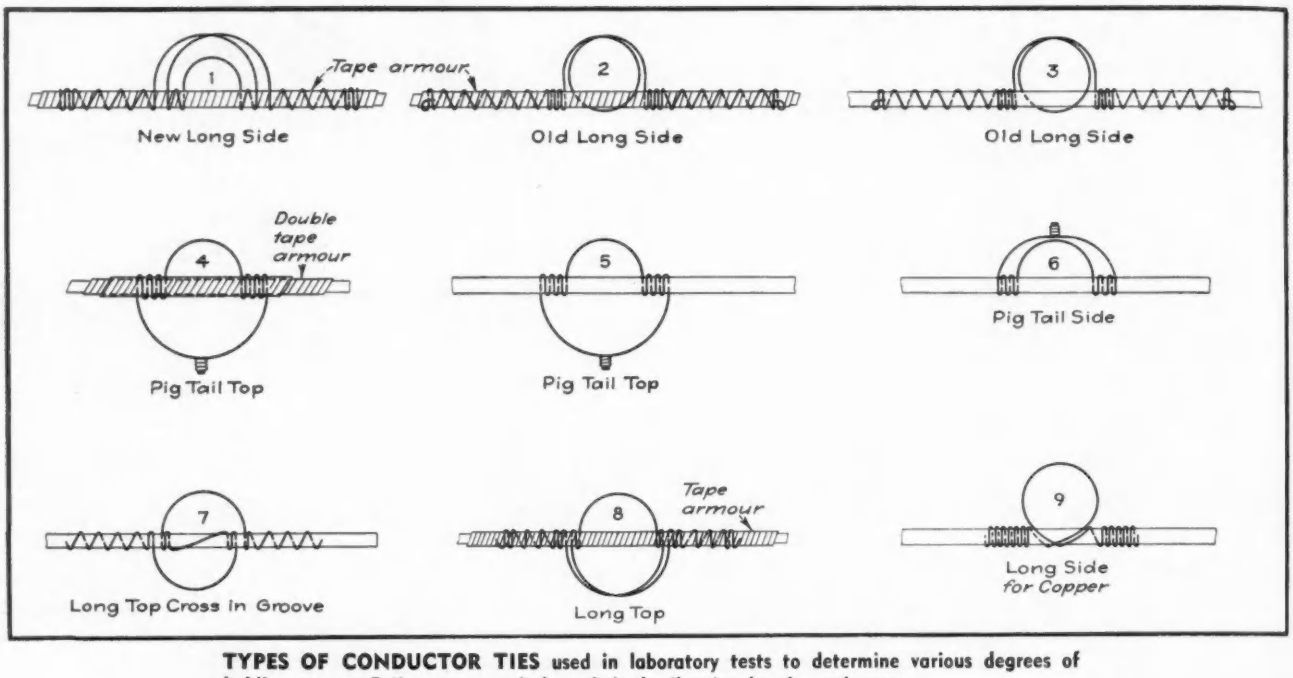
Design your substations "ALL-ALUMINUM" . . . to save time, money, inconvenience. We'll be glad to help. ALUMINUM COMPANY OF AMERICA, 2138 Gulf Building, Pittsburgh 19, Pennsylvania. Sales offices in leading cities.



MORE PEOPLE WANT MORE ALUMINUM FOR MORE USES THAN EVER

ALCOA FIRST IN ALUMINUM

IN EVERY COMMERCIAL FORM



TYPES OF CONDUCTOR TIES used in laboratory tests to determine various degrees of holding power. Failures occurred through both vibration breaks and wear

TABLE I—Pull at Which Conductor Slipped Through or Tie Failed

Tie Type	Fig No.	Failure, lb End Pull	Failure, lb Vertical Pull
No. 4 ACSR—No. 6 Tie Wire and Flat Armor Tape			
Long Side	1	570	1240†
Pig Tail Top	4	500	730
Long Top	8	820*	1000
No. 4 Copper Wire—No. 6 Tie Wire			
Long Side	3	330	1000+
Pig Tail Top	5	30	1000+
Long Top	8†	45	1000+

* Tie wire failed
† Without armor tape.

TABLE II—Breaks and Wear at Ties On Stranded Rural Conductors

(Conductors were mostly ACSR No. 4 to No. 110 with a few lines of stranded copper)

Ties Type	Fig No.	Inspected	Vibration Breaks Cond.	Vibration Breaks Tie Wire	Vibration Breaks Armor Tape	Wear Only Cond.	Wear Only Tie Wire	Wear Only Armor Tape
Old Long Side, armor tape	2	531	11	4	2	17	8	8
Old Long Side, no armor	3	186	4	—	—	37	—	—
Pig Tail Top, no armor	5	84	11	—	—	18	—	—
Pig Tail Side, no armor	6	24	—	—	—	10	—	—
Long Top, no armor	7	48	6	—	1	9	—	—
Long Top, armor tape	8	578	7	—	1	2	—	3

Powers of various types of conductor ties are indicated in Table I by the amount of pull required for a conductor to slip through or a tie to fail. The values were determined by laboratory tests of some 500 ties.

Fatigue failures of tie components have two classifications—vibration breaks and wear. An indication of occurrence is listed in Table II. Here is the result of a field inspection of 1,450 ties on various lines in Ontario. The inspections were made at exposed locations on the lines and not a continuous run of poles.

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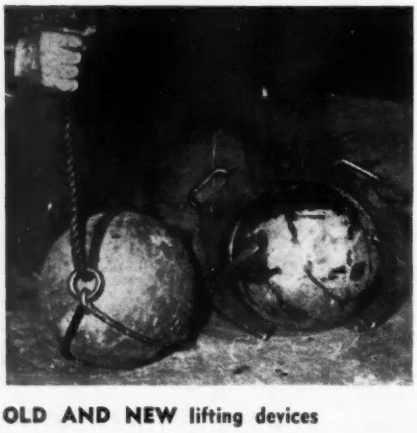


OLD AND NEW lifting devices

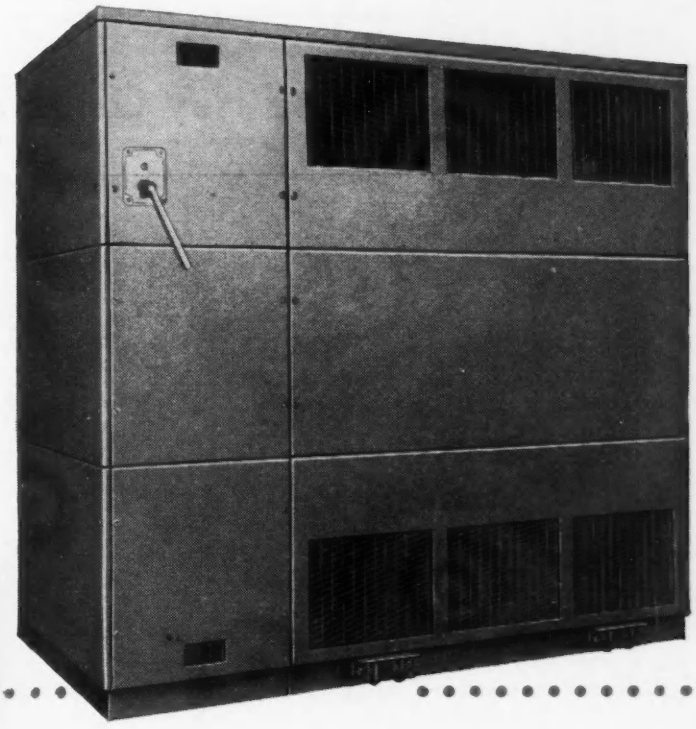
Cradle Handles Pulverizer Balls

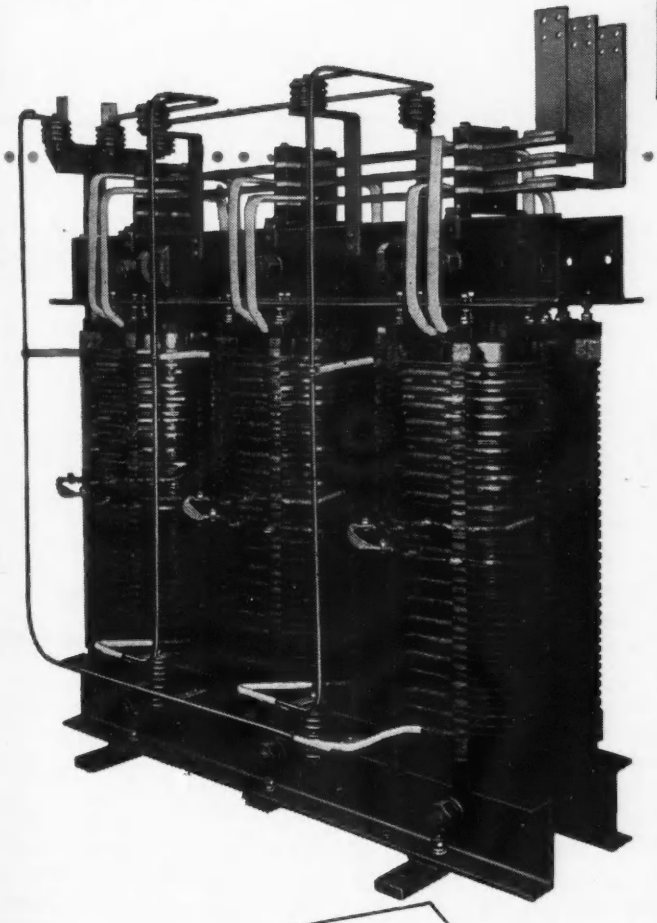
CRADLE of the rod-and-rope type was devised for safe and quick handling of 125-lb iron balls. It was developed by employees at the Acme Station of Toledo Edison Co, Toledo, Ohio. The balls rotate in the grinder of the company's coal pulverizer machinery. At right is a pair of the cumbersome tongs formerly used. The comparison between these two handling methods is readily apparent. The newly designed cradle results both in appreciable savings in time and in a greatly increased factor of safety for the operating personnel concerned. Cost of building this cradle was extremely low when compared with the expense formerly entailed in producing the now-obsolete lifting tongs.

Wagner Dry-Type Indoor Transformers

Now available in ratings from 100 to 2000 kva

To meet industry's growing need for larger indoor dry-type load center transformers, Wagner has broadened its line of three-phase dry-type transformers to include ratings up to 2000-kva in the 15-kv class and below. Especially developed for plant power distribution circuits, these units are compactly housed in neat, attractive enclosures, which can be arranged to include primary and secondary switchgear compartments to form readily accessible, closely-coupled unit substations. Complete enclosure of all equipment protects against accidental contact with live parts. Relatively light in weight, so that they can be used in multi-story buildings, they are readily adaptable to any installation requirement.





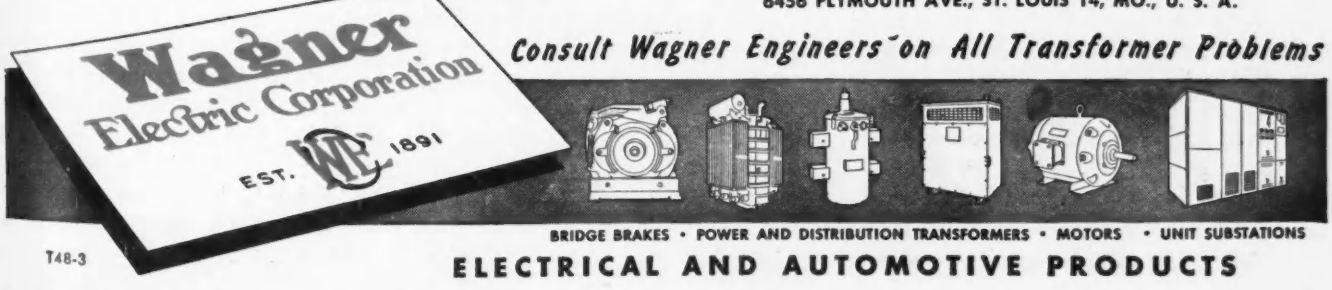
More than fifty years of transformer building experience has been incorporated in the design and construction of these transformers. The coil conductors are insulated with double servings of fiber glass. The windings are insulated from each other and from the core and mechanical parts using Class B and Class C materials, the latter being employed where extra strength is required. The core is sturdily constructed, and both the core and the coil stacks are provided with vertical ducts for effective cooling. The entire core and coil assembly is given successive baked coats of heat resistant synthetic varnish which produces a tough, high gloss finish. The connections between phases and to the switch gear are securely braced and well insulated from each other and from ground, and the conducting surfaces of all clamped joints are silver plated to prevent corrosion.

Transformers can be furnished with equipment for indicating winding temperature. Fans for increasing the capacity 25% may also be provided when the possibility of load growth warrants this addition.

Bulletin TU-56 describes in detail the transformers, the enclosures, the various types of incoming line sections available, and the optional equipment and accessories that can be furnished. Write for your copy today.

Wagner Electric Corporation
6456 PLYMOUTH AVE., ST. LOUIS 14, MO., U. S. A.

Consult Wagner Engineers on All Transformer Problems



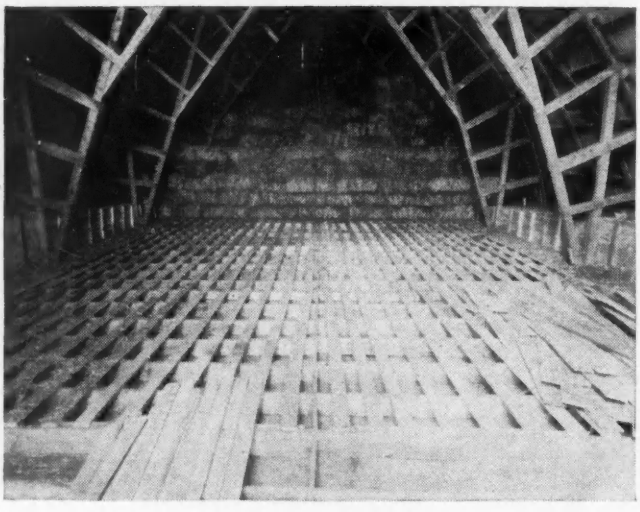
BRIDGE BRAKES • POWER AND DISTRIBUTION TRANSFORMERS • MOTORS • UNIT SUBSTATIONS

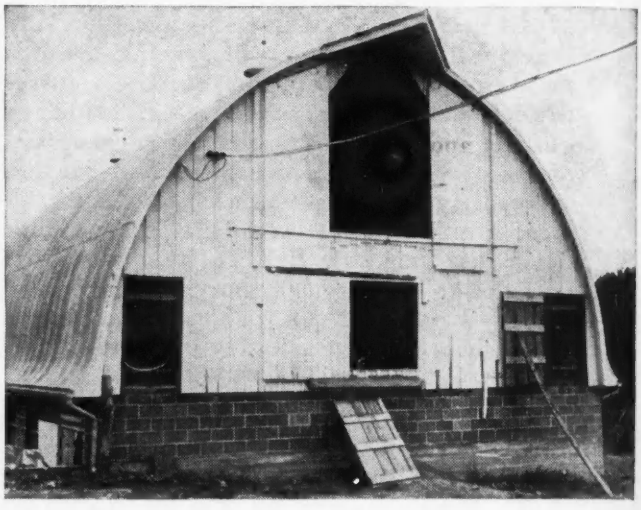
T48-3

ELECTRICAL AND AUTOMOTIVE PRODUCTS

LOAD BUILDING

Baled Hay Cured at 2 Kwhr per Bale





DOUBLE DUCT HAY DRIER combines clear mow floor and flexible operation

J. W. HALL and A. W. COOK
Agricultural Engineers
Appalachian Electric Power Co
Roanoke, Va.

IN THE ROANOKE DISTRICT of Appalachian Electric Power there are 44 hay curing systems, 14 of them put in in the past year. Of these, the first 40 installed were for long hay. We were confronted with a rather new problem when Harold Craun, one of our farm customers, asked us to design our first installation for drying baled hay. There are now 4 baled hay systems in the district.

The mow of Mr Craun's dairy barn is 35 ft wide and 78 ft long. At the side, 15 ft from one end, is a hay chute, leaving an area 35 by 63 ft for the dryer. A 2-fan system was designed with main ducts on each side of the mow. In the center of the slatted floor is a partition so that either fan can be operated for its half of the floor independently of the other. Additionally, each main duct has an air gate in the center and the front half of each duct's outlets to the floor can be closed off by a long-hinged flap. Thus air can be furnished to the whole mow floor, to either side-half or either end-half, or to any quarter. This is a most flexible operating arrangement.

Two 42-in. Aerovent fans driven by 7½-hp motors supply the air. Each fan is rated at 26,600 cfm at ½-in. static pressure and 17,400 cfm at 1½-in. The mow floor was designed with an air-release area of 56 by 26 ft, 1,456 sq ft. The system was figured on the basis of 20 cfm per sq ft at 1½-in. static pressure, the output of the two fans being more than ample. With the mow fully loaded, the static pressure did not reach 1½-in. and it does not appear necessary to design for any more than 1-in. in future installations of this kind.

Part of the first cutting of alfalfa, 1,000 bales, was cured on the back half of the dryer. These bales were then moved to the end of the barn. The second cutting, 2,800 bales, was piled over the whole air-release area. Half of the area was then cleared, and the third cutting, about 1,200 bales, was placed on it. The bales were stacked 8-high (about 10-ft), in staggered layers so that cracks between bales were blocked off, and packed as tightly as possible. Energy used to cure the total 5,000 bales was approximately 10,000 kwhr, an average of about 2 kwhr per bale.

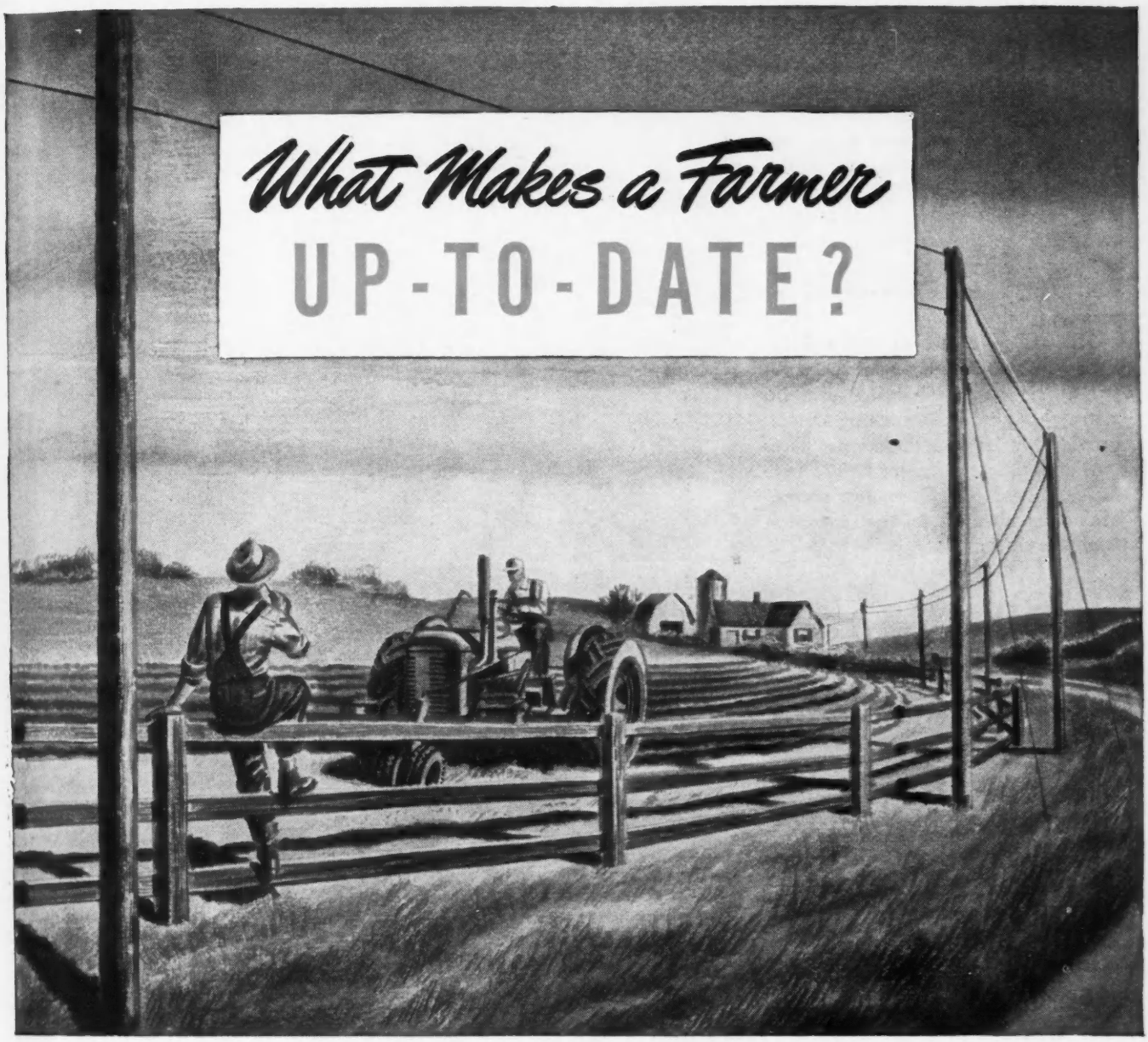
Last October Mr Craun wrote and gave to us a "To Whom It May Concern" letter stating his complete satisfaction with the installation and recommending one like it to "any dairy farmer who desires good, first-class, high-protein hay." Also he has ordered equipment to enlarge his hay curing capacity to 10,000 bales.

•

5.4-Kw Fixture Lights Noted Art Gallery

W. D. GORMAN
Illuminating Engineer
Hartford Electric Light Co
Hartford, Conn.

IN GALLERY LIGHTING, it is essential that main attention be directed on the objects to be viewed. An outstanding case is that of Tapestry Hall in the Morgan Memorial Gallery, Wadsworth Atheneum, Hartford, Conn. Quality light had to be focused on the walls carrying the tapestries. General over-all lighting was needed for a large, high-ceilinged gallery. Above all, the lighting had to be unobstrusive. This was accomplished



IT IS instinctive for the farmer to seek new things . . . labor saving machinery, improved hybrids, pest control, control of soil erosion . . . to increase his production.

Electric power is the greatest single contribution of modern times to agricultural efficiency. Electricity means heat, light and *power* . . . energy that today's farmer knows well how to use.

As the use of electricity grows, it becomes increasingly important that power lines do not fail. Power flows best through copper . . . and copper will not rust—the best assurance of long, trouble-free service. Anaconda Wire and Cable Company, 25 Broadway, New York 4, N. Y. 49453

BARE COPPER WIRE AND CABLE
COPPERWELD-COPPER COMPOSITE CONDUCTORS
*DURALINE WEATHERPROOF SERVICES

**An Anaconda Trade-Mark*

LOOK TO *Anaconda* FOR CONDUCTORS THAT LAST!

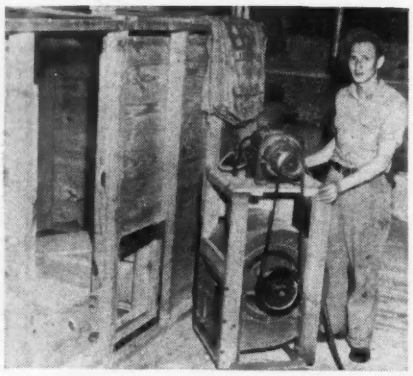
ANACONDA

by a special Lite-Control fixture suspended 26 ft above the floor. It comprises 18 units, each having six 4,500-deg white 40-w fluorescent tubes. The fixture is 72 ft long and with ballast has a rating of 5.4 kw. The fixture is provided with a special pluralite glass to obtain the necessary color characteristics for tapestry display. The V-shaped glass allows maximum intensity.

The hall is 83 ft 6 in long x 46 ft high x 32 ft wide. Hangers about 17 ft long suspend the lighting units in a straight line. The switching system provides various combinations: Two outside lights; two center lights; two inside lights; and alternate fixtures. Maximum intensity on the tapestries is about 35 ft-c.

TAPESTRY HALL provided with glareless illumination from single fixture traversing upper center of room. About 35 ft-c delivered on vertival plane at side walls adequately illuminates tapestries and other exhibits that are on display

Portable Blower Saves Corn



SQUARE duct opening of grain drying bin matches up with fan discharge

SEVERAL HUNDRED dollars worth of shelled corn were saved on the Nakoma Farm at Fairport, near Rochester, N. Y., by the use of a portable blower. The corn was slowly spoiling in the two bins containing it. Working with the farm service representative of the Rochester Gas & Electric Co, Ernest Wicks, manager of the farm, mounted a centrifugal fan and a 1 hp motor on a frame riding on casters. He built a couple of new bins 8 ft square and 6 ft deep. These are floored with fine mesh screen supported on two-by-fours, and have tapered ducts in the centers to discharge the air under the floors. The square mouths of the ducts were sized and positioned to line up with the fan discharge. The fan is alternated between the two bins to keep the grain in them dry and clean.

High Intensity from A High Ceiling

The Edwin F. Guth Co.

OVER 90 FOOTCANDLES is the intensity maintained on work tables in the new engineering and drafting room of the Austin Co, Cleveland, Ohio. Mounted in the arched ceiling of the 70 x 140 ft area are 24 lines of recessed troffer fixtures on 3-ft lateral spacing. Each fixture contains 4 troffers and is spaced 4 ft from the next. Mounting heights vary from 13 to 22 ft. Each troffer contains a pair of 40-w lamps, one Daylight and the other Soft-White. Lower lamp brightness and better diffusion results from this alternation of color quality. Overall color temperature is about 3,500 deg white. Quick starting ballasts, avoiding use of starter switches, reduce maintenance—a particular advantage with the high mounting of the fixtures

Only WESTINGHOUSE TYPE EA FUSE CUTOUTS

OFFER ALL THESE ADVANTAGES

PORCELAIN-ENCLOSED FOR SAFETY. Prestite porcelain provides dimensional fidelity, and assures interchangeability of doors: dropout and non-dropout fuse doors, disconnect blade door.

COMPLETE HOOKSTICK OPERATION for extra safety. Door is easily inserted or removed, opened or closed with hookstick . . . no danger of contact with live parts.

FEWER JOINTS IN CURRENT PATH result in cooler operation, less maintenance and longer life. Two to seven less joints in current path than in other cutouts.

NON-SWELLING FUSE TUBE cuts maintenance, increases life. Fiber lining (to help extinguish arc) is enclosed in moisture-proof Micarta.

FULL 180° DROPOUT removes fuse holder from both contacts after interruption. Blown fuses are readily spotted on the line.

EASY FUSE RENEWAL speeds maintenance. Lineman can change fuses without tools, and without removing gloves.

...adding up to *lower maintenance, longer life, greater reliability* . . .

Packaged complete in one carton, EA Fuse Cutouts permit fast installation without separate handling of brackets and other parts. Store the EA on your service trucks . : : and be sure your men have everything *once on location*. This greatly simplifies accounting and storage.

Accurately dimensioned Prestite porcelain housing accommodates three types of doors, making possible interchangeability which saves time and simplifies servicing. Fuse replacement is fast and easy, even with gloved hand, under any weather condition. No tools are required. *No other cutout* has the list of advantages mentioned here . : : backed by decades of Westinghouse experience.

EA Fuse Cutouts are available from stock in ratings of 50 and 100 amperes at 5 and 7.5 kv.

Phone your local Westinghouse office for B-3833, or write Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-60584-A

Westinghouse

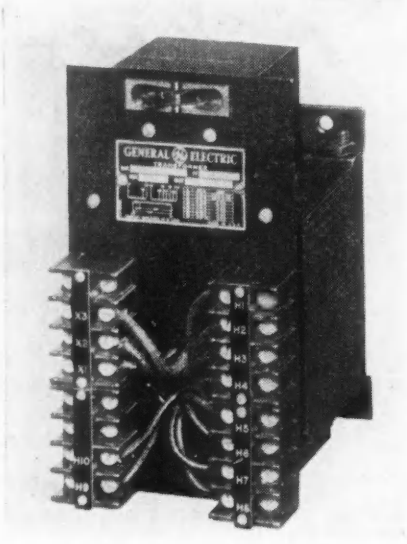
PLANTS IN 25 CITIES... OFFICES EVERYWHERE

TYPE EA FUSE CUTOUT

NEW EQUIPMENT

Machine Tool Transformers

A LARGE SEGMENT of domestic machine tool transformer requirements is said to be provided for by ten ratings ranging in size from 0.075 to 3 kva for use on 60-cycle circuits of either 220 or 440 volts. Designed for that purpose, a line of transformers has been announced by the Specialty Transformer Division of the General Electric Co.



For 25-cycle applications these transformers are listed in four standard sizes ranging from 0.15 to 0.5 kva. These units have primary voltage taps for 220, 440, and 550 v. To complete the line, an all-purpose group of transformers rated for both 50- and 60-cycle supply circuits is provided. The primary is equipped with eight voltage taps ranging from 208 to 550 v. They have standard 110-v secondaries with 92-v taps for operation of 60-cycle relays on 50-cycle circuits.

Design of the transformers provides control panel mounting. Damage to the transformer even under sustained overload or accidental short-circuit conditions is said to be prevented by a built-in overload protector with time delay action.

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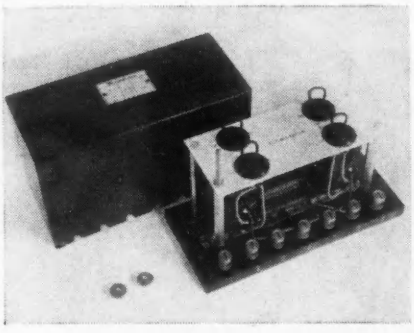
Phase-Shifting Transformers

A LINE of adjustable phase-shifting transformers that will convert standard watthour meters to kva-hr meters by



the displaced voltage method is announced by Westinghouse Electric Corp, East Pittsburgh, Pa. The new transformers shift the voltages by 0, 30, 45, and 60 deg corresponding to 100, 86.6, 70.7 and 50 percent power factor respectively depending upon the position of movable plugs inserted in radio-type sockets built into the unit.

As power factor of the load differs from that for which the transformer is set, errors in registration increase but in no case exceed 2 percent so long as the phase angle of the load is within 11 deg of the tap setting, it is claimed.

Transformers available are type K-12 for 2-phase, 3-wire connections; type K-13 for 3-phase, 3-wire connections; type K-14 and K-18 for 3-phase, 4-wire connections, and type K-17 for 3-phase, 4-wire delta connections.

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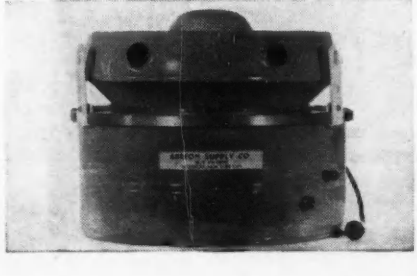
Industrial Humidifier

NEW MODEL of a Walton industrial humidifier features a lower pan completely covered and the air brought in from the bottom through a glass filter. It is being made available by Abbeon Supply Co, 58-10 41st St, Woodside, N. Y. C. Other features include: self-contained; ceiling mounted; water vaporization capacity over one gallon per hour; directional domes; motor operated, less than 100 watts per unit; single water pipe (no return).



Cathode-Ray Tube

A NEWLY DEVELOPED NORELCO cathode-ray tube, designated type 3QP1, for oscilloscope use is short, has a flat face, and provides improved electron-optical characteristics, particularly at the screen edge. The tube is stated to have improved cross-talk characteristics between deflection-plate pairs. It is especially suited to the design of unusually small, lightweight service equipment needed in television installation and maintenance work, according to an announcement by North American Philips Co, Inc, 100 East 42nd St, New York.

Over-all length of the 3QP1 is only 6⅛ in. and face diameter is 2¾ in. The tube utilizes P1 (green) phosphor and has electrostatic focus and deflection. Rated heater drain is low; 0.3 amp at 6.3 v. Capacity between terminals varies between 2 and 9 $\mu\mu$f.

•

Poultry Time Switch

THE Plug-In is the latest addition to a line of poultry-house time switches manufactured by Paragon Electric Co, 1661 Twelfth St, Two Rivers, Wis.

This time control for artificial lighting was designed for smaller poultry raisers having flocks such as 50 to 400 layers. The switch with an electric clock provides for evening dimming period of 20 min to induce safe roosting before lights are turned off. A 6-ft cord plugs into any convenient 115-v, 60-cycle outlet. Extension cords for both the bright and the dim lights are plugged into receptacles at the sides of the case.

Artificial henhouse lighting is ordinarily controlled from early fall to late spring. During the other months the switch can be used to control barn hay-drying, yard lights, water pumps and other farm equipment.

•

Fluorescent Fixtures

IN A LINE of Linolite commercial fixtures is the new 97-in. long series 32 Slimline developed by the Frink Corp, 27-01 Bridge Plaza North, Long Island City, N. Y. This fixture is available with either two or four lamps for 100, 200 or 300 ma operation. Only 5⅛ in.

HUBBARD AUTOGAP FUSE CUTOUT

NO. 2315

HUBBARD AUTOGAP FUSE CUTOUT is a combination of No. 2302, 9 KV Autogap Lightning Arrester with a new, improved 7-1/2 KV open type fuse cutout. The assembly is Stock No. 2315.

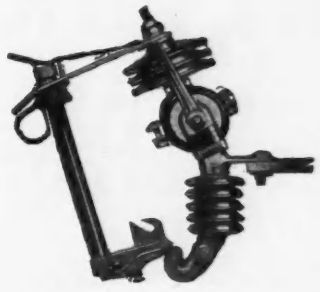
VOLTAGE, phase to ground is recommended to be limited to 7500 Volts.

FUSE rating is 50 Amperes. Fuse links are not furnished. Any standard can be used.

INTERRUPTING CAPACITY of the Hubbard Autogap Fuse Cutout is 1200 Amperes.

MOUNTING Brackets are available. No. 2323 for Crossarm and No. 2325 for pole. Specify type of mounting when ordering.

WEIGHT of the assembly is 18 Pounds each, packed for shipment.



CLOSED POSITION: The flat, phosphor bronze spring at the top is in tension, ready to kick out the mechanism instantly when the blowing of the fuse releases the tension.

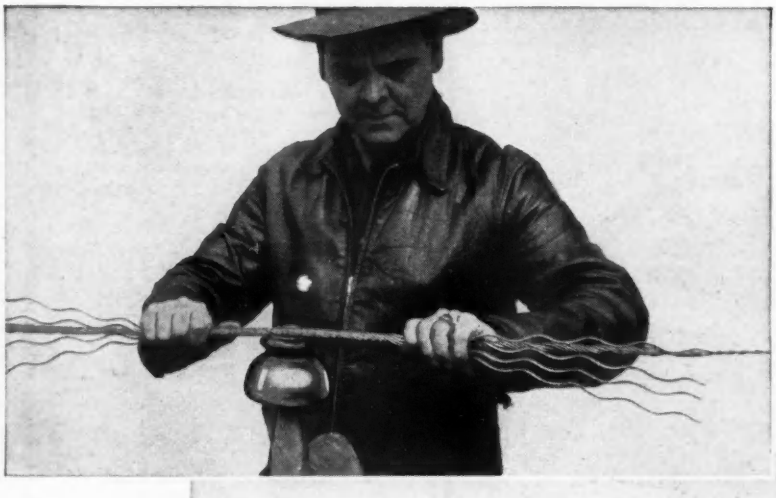
OPERATING: This view shows the action during transition from "closed" to "open" positions. The fuse has blown and the toggle mechanism is forced open by the top contact spring. The gap caused by the blown fuse is instantly lengthened to at least 3-inches by the leverage of the toggle mechanism, causing the arc to be extinguished within the fibre fuse tube rather than at the top contacts, where burning might occur.

OPEN POSITION: Top contact spring is relaxed, having exerted its pressure toward opening the mechanism. Tube drops to hanging, open position which places the notch for "hot-stick" removal of fuse tube in an accessible spot

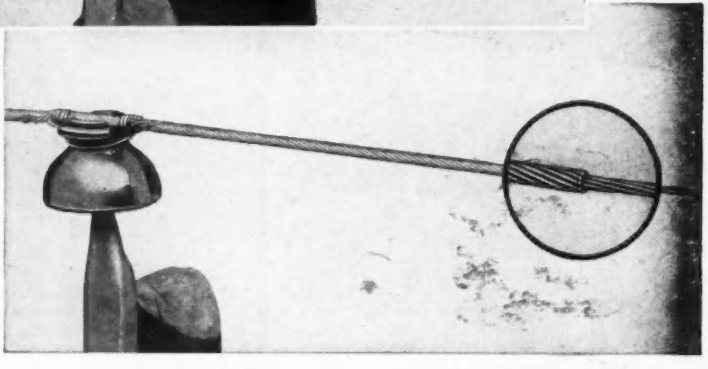
HUBBARD AND COMPANY

PITTSBURGH · CHICAGO · OAKLAND, CALIF.

PREFORMED ARMOR RODS



Quickly, easily applied



SAFE-GUARD CONDUCTORS AT LOW COST

1. Reinforce conductors at supports
2. Dampen vibration
3. Minimize wear
4. Protect against arcing
5. Increase holding power
6. Reduce corrosion

Preformed Armor Rods provide a dependable, economical way to reinforce and protect overhead conductors and static wire at the point of and in the region of the support. They minimize wear and chafing, tend to absorb and dissipate vibration, protect the conductor against arcing and flashovers, reduce the possibility of corrosion, provide excellent holding power against slippage.

Easily and quickly applied by hand or with "hot-line" tools. Available in galvanized steel, aluminum, copper or bronze.

Write for Descriptive Bulletin, No. PR-100.

INDIANA STEEL & WIRE COMPANY · MUNCIE, INDIANA

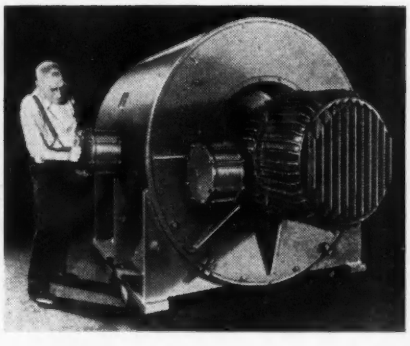
deep, it features glass side panels and interchangeable hinged louver or glass door bottoms.

A series 22 is a 49-in. waffle type fixture available with 2, 3 or 4 lamps for ceiling or hanger mounting, singly or in continuous runs, and in combination with matching incandescent downlight boxes.

•

Wound-Rotor Motors

A LINE OF IMPROVED totally enclosed, fan-cooled, wound-rotor motors has been announced by Allis-Chalmers Mfg Co, Milwaukee, Wis. The motors are built with a tube-type air-to-air heat exchanger, reported used previously for squirrel cage motors. The greater efficiency of this exchanger is said to permit a reduction in size compared to older, totally enclosed, fan-cooled designs.



The improved motors are suitable for all fields of industry, since they can be readily adapted to suit the requirements of any special industry, the company reports. To assure trouble-free operation under extremely unfavorable atmospheric conditions, the motors can be built with stainless steel ventilating tubes, fans, and end plates and cast iron terminal boxes and collector ring enclosures.

Built with these special features, the 500-hp, 705-rpm, 2300-v motor shown is to drive a centrifugal pump in a midwestern chemical plant. The collector assembly is cooled by radiation, with internal air circulation provided by fan blades mounted on the collector assembly.

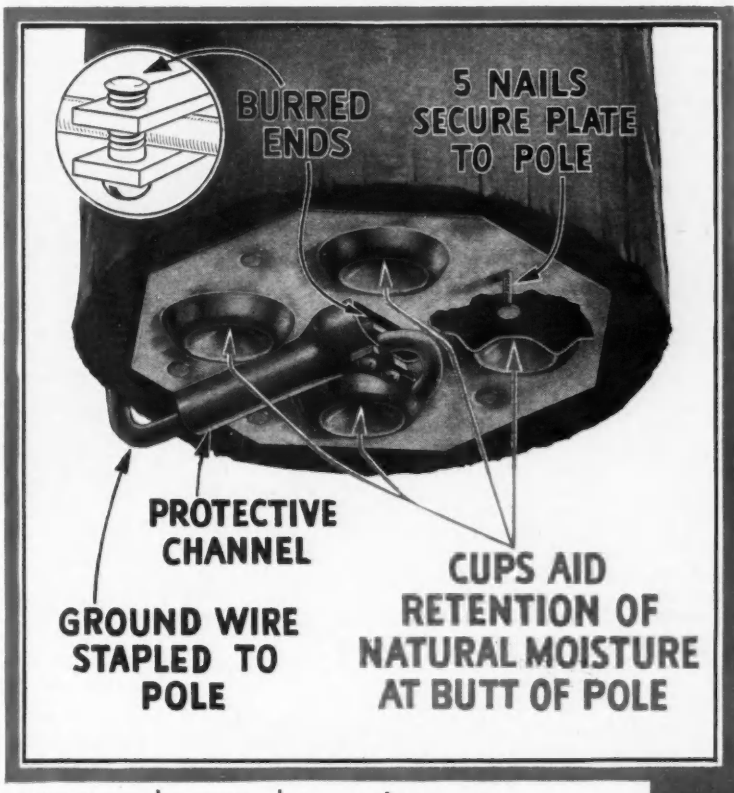
•

Welding Timer

THE No. 52D Timatron, and electronic welding timer, for spot welding machines is a development of Ripley Co, Inc, Middletown, Conn. Once set for a particular thickness of metal, timing becomes automatic throughout the entire production run, it is reported.

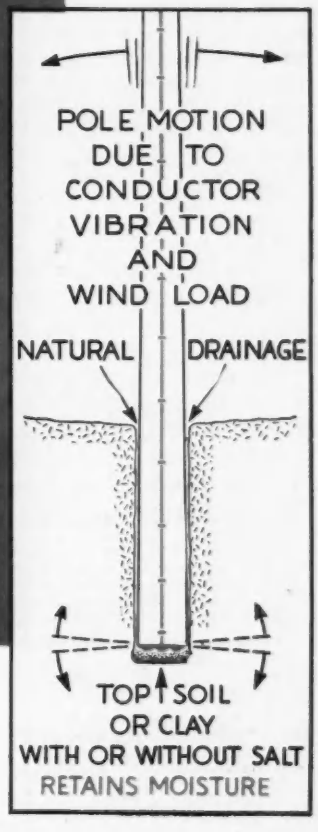
The control has the capacity to time any machine up to 10 kva, and is adjustable from 0.1 to 5 sec by a hand

PUDDLING does it !


BURRED ENDS
5 NAILS SECURE PLATE TO POLE
PROTECTIVE CHANNEL
GROUND WIRE STAPLED TO POLE
CUPS AID RETENTION OF NATURAL MOISTURE AT BUTT OF POLE

T&B ENGINEERED

REA APPROVED


POLE MOTION DUE TO CONDUCTOR VIBRATION AND WIND LOAD
NATURAL DRAINAGE
TOP SOIL OR CLAY WITH OR WITHOUT SALT RETAINS MOISTURE

Out of years of laboratory and research experience on grounding problems, T&B engineers have designed this unique pole ground plate to fill a specific need for Utility engineers.

Special engineering studies have been made which indicate that the common practice of salting a ground does little more, in effect, than to retain a moisture content in the earth *adjacent* to the grounding device.

The Thomas & Betts Pole Ground Plate* #5575 was designed to *retain the moisture where it is most needed*, and so effect a continuously better ground.

Using the principle of keeping mud pies moist by "puddling", our engineers devised the four built-in cups to puddle the mud under the constantly vibrating poles. This, plus the total weight of the pole and its load, affords the high pressure contact so desirable in all electrical connections.

Ask us for a sample of this latest T&B contribution to Utilities.

*Pat. Applied For

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Manufacturers of Electrical Fittings Since 1898
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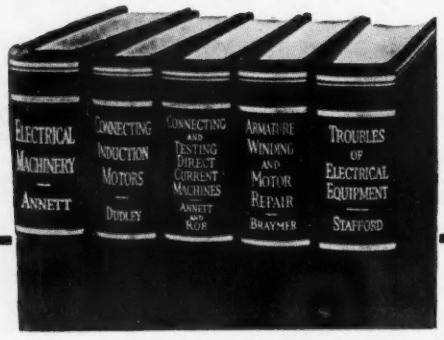
It's *your* future—make the most of it!

Start now to earn the bigger pay in electrical repair


Electrical Machinery — Annett
Connecting Induction Motors — Dudley
Connecting and Testing Direct Current Machines — Annett and Roe
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Includes trouble-shooting book
Now in addition to four-well known practical books on all details of testing, connecting, rewinding, installing and maintaining electrical machinery, the Library includes Stafford's *Troubles of Electrical Equipment,* a handy book giving helpful maintenance information, special trouble-shooting charts, explanations of symptoms and causes of machinery troubles, specific remedies, etc. This revised library gives you the ability to handle bigger jobs with surety of results.

Hundreds of helpful diagrams

The hundreds of photographs, diagrams and tables contained in these books alone are a valuable feature. There are wiring diagrams covering A.C. and D.C. generators, feeders, transformers, potential regulators, synchronous converters, batteries and boosters, substations, lamp mechanism connections, rheostats and controllers, lightning arresters, automatic switches, railway controllers, etc.

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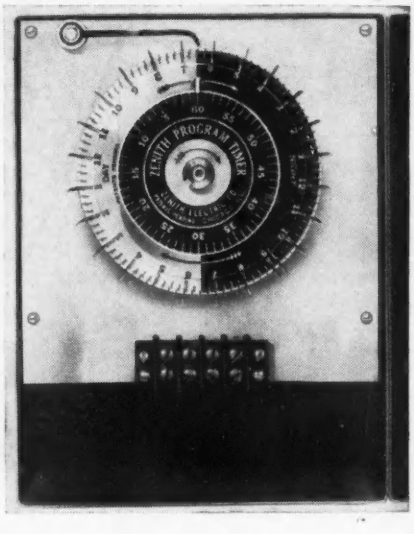
control covering any timing range which may be desired. The dial, which adjusts the timing period, is calibrated so that adjustment can be speedily made when switching from one thickness of metal to another. Dimensions are 4¾ in. deep, 5⅛ in. wide and 9 in. high.

•

Program Timer

A PROGRAM TIMER, developed by Zenith Electric Co, 152 W Walton St, Chicago 10, Ill., acts as a "reminder" at predetermined intervals of time. The unit can be set to sound a bell or

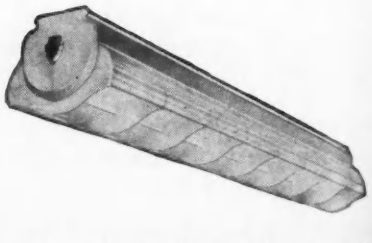


other signal at 15-min. intervals for 24 hr a day. The type P-15-24 can be automatically set by turning the minute hand as with an ordinary clock. Circuit closure will give signal from 2 to 60 sec duration as desired.

•

Fluorescent Fixture

ALL-PLASTIC LOUVERING in a commercial fluorescent lighting fixture is being featured by HOLDENline Co, 2301 Scranton Road, Cleveland, Ohio, in its



new Arrowhead unit catalogued as CP-240. (Patents applied for). The manufacturer claims this to be the first commercial unit to feature controlled brightness without contrast. The low surface brightness equals about 1 candlepower per square inch on the sides.

The rigid, all-plastic louvers are self-

"LINE DOWN on the Warrenville Road

—*the crew will be there pronto!*"

FILTHY weather, not fit for man or beast, but maintenance crews have to get there. A line can't stay down. And the Highway Maintenance Body, like the men who ride in it, is always prepared for emergency work—a place for all needed tools and materials, and everything in its place!

There's no accident about the efficiency of Highway equipment. Take that Maintenance body for instance—it is *organized* for quick convenience as a result of years of close familiarity with all the problems involved. It's the same way with all other Highway equipment.

Highway Earth Boring Machines do double duty as pole derricks, saving an extra truck and crew. Highway Pole Trailers and Cable Reel Trailers are designed to save time and manpower. Highway Winches and Power Take-offs have the enthusiastic approval of leading engineers. Highway's long and successful experience can provide answers for your particular needs. Write to us!

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for instance...

This is a Locke No. 0611-44 wireholder — one of a complete line—for installing secondary circuits on poles and buildings.

The hardware is accurately formed to fit the porcelain, and has *Permazinc*—Locke's *Quality Controlled* double hot-dip galvanizing—for extra years of dependable performance. Screw threads are sharp and clean for easy installation.

The wireholder is so designed that, when load is applied, the porcelain is in compression for maximum strength. Porcelain is *Compression Glazed* —an original Locke process—for added strength. Hardware and porcelain are designed together and made together to work together.

Complete lines of distribution materials are maintained in six Locke regional warehouses and in most distributors' stocks. Get in touch with your Locke representative.

Depend on Locke for ***Quality Controlled*** distribution materials—pole line hardware and insulators. *One* order covers *both*.

Locke **POLE LINE HARDWARE** *and* **INSULATORS**

LOCKE INSULATOR CORPORATION • BALTIMORE 3, MD.

locking and non-warping. They are easily removed or attached for easy, quick maintenance. Ballast is enclosed in steel channel. All the versatile features of the Chan'l-Run basic unit system are retained.

•

Isothermal Quench Furnace

A NEW DESIGN of the Ajax Hultgren electric salt-bath furnace is being offered by Ajax Electric Co, Philadelphia 23, Pa. For use with the Ajax isothermal heat treat process, the quench furnace employs the principles of a heat exchanger to hold the quenching bath at a constant temperature.

A motor-operated, high capacity, submerged pump is provided. The pump outlets are stated to subject the work to a fast moving stream of molten salt which gives the quenching power of warm oil.

To eliminate contamination of salt in a two-furnace set-up, a salt separator is immersed directly in the isothermal quench bath. The separator is comprised of a screen filter and an air pump. The precipitate is collected in the screen filter and the clarified quench salt returns to the bath.

The isothermal quench furnace can be heated either by immersed electrodes for high-temperature work, or by immersion heating elements for low-temperature work.

•

Insulator Fork

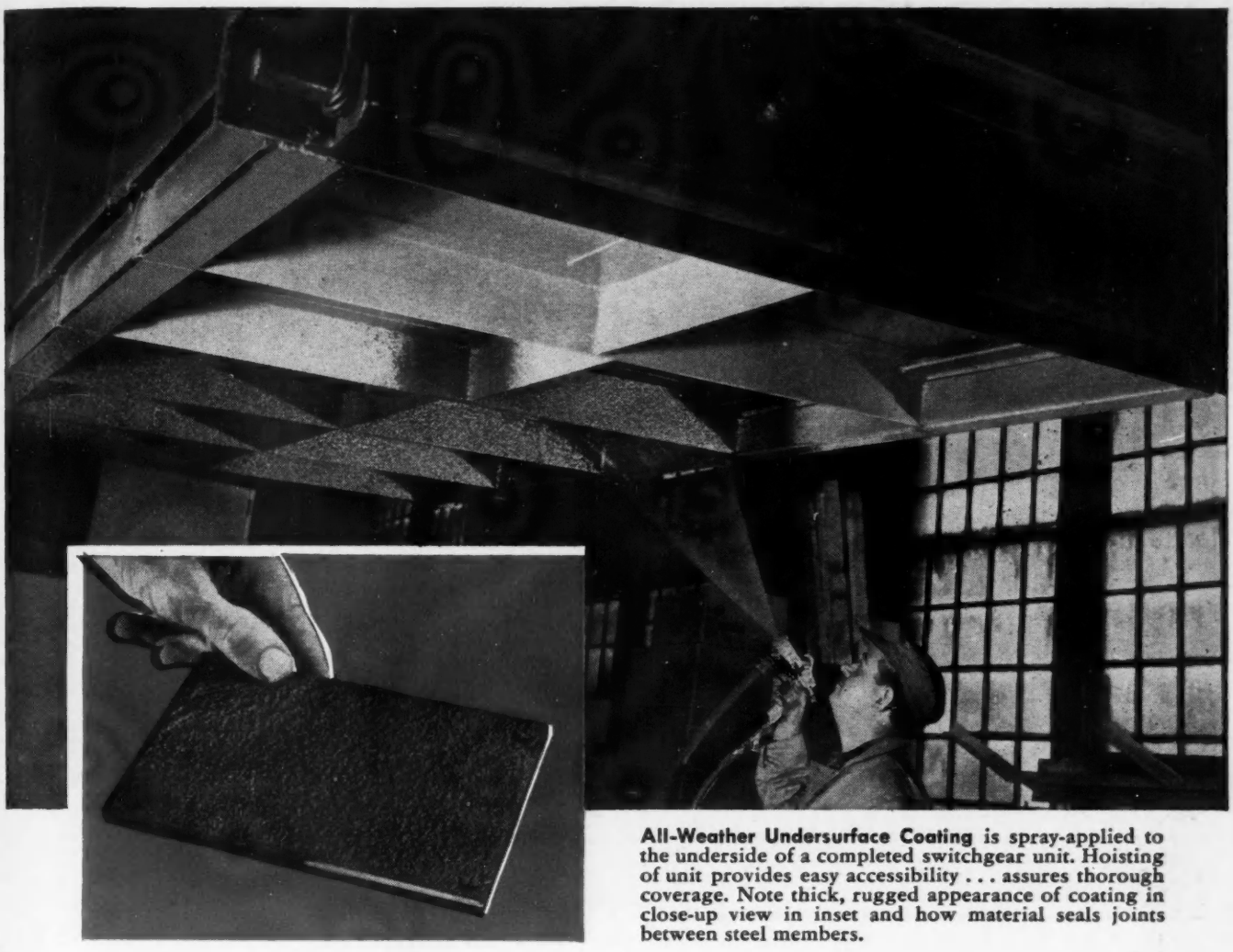
AN ALUMINUM fiber-jawed adjustable insulator fork is a new hot-line tool manufactured by A. B. Chance Co, Centralia, Mo. The tool attaches to an insulated universal pole which, when turned, opens or closes the jaws. The fiber jaws are said to permit a firm grip on the insulator without damaging the porcelain or the cement seal at the junction of the porcelain and malleable cap.

The fork can be used to control 8-in. and 10-in. dead-end insulators while making insulator changes on energized lines. It is reported that it can also be used to raise most pin type insulators weighing up to 15 lb. A wing nut and groove arrangement on the aluminum alloy casting allows the jaws to be set at 0, 30 and 60 deg to the spline screw so that pin type insulators can be placed in position on a crossarm.

•

Flat-Stem Thermometer

A THERMOMETER with 3-in. and 5-in. dials and designed to clamp on flat surfaces has been developed by W. C. Dillion & Co, Inc, 5410 West Harrison



All-Weather Undersurface Coating is spray-applied to the underside of a completed switchgear unit. Hoisting of unit provides easy accessibility . . . assures thorough coverage. Note thick, rugged appearance of coating in close-up view in inset and how material seals joints between steel members.

Protection against rust and corrosion now starts at the bottom

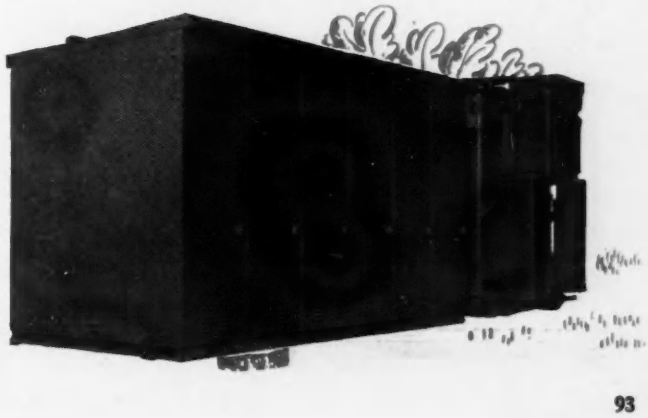
. . . of Westinghouse Outdoor Metal-Clad Switchgear

This new feature . . . All-Weather Undersurface Coating . . . now promises lower maintenance cost and longer life for Westinghouse Outdoor Metal-Clad Switchgear. It's a rugged coating of the bottom surface that combats rust and corrosion by shutting out moisture, dust and dirt. And it saves you the cost of repeated paintings under difficult conditions.

This new All-Weather Undersurface Coating for outdoor switchgear is a heavy rubberized underseal. It's just like the undercoating applied to automobiles to protect them against severe weather, salt and other corrosive street chemicals.

Switchgear undersurfaces are first cleaned, bonderized and prime-painted. Then, the All-Weather Undersurface Coating is applied. This is done by spray to insure complete, uniform coverage. The result is a thick, air-tight seal . . . lasting protection against costly deterioration of undersurfaces.

For complete information on Outdoor Metal-Clad Switchgear, call your nearest Westinghouse office or write to Westinghouse Electric Corporation, P. O. Box 868, Pittsburgh 30, Pa. J-60655



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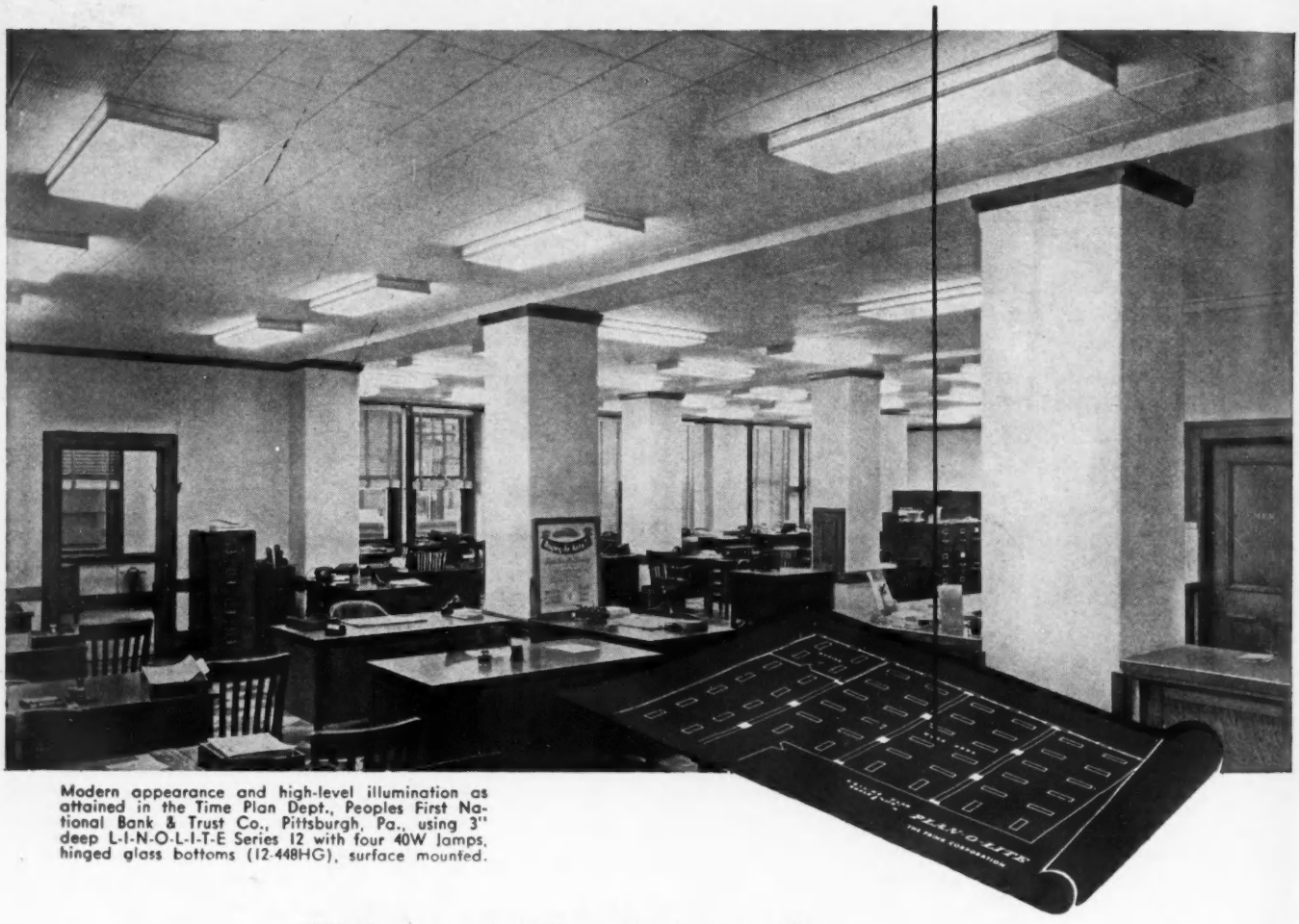
OUTDOOR METAL-CLAD SWITCHGEAR

GUARANTEED LIGHTING BEGINS WITH A FRINK *PLAN-O-LITE*



Modern appearance and high-level illumination as attained in the Time Plan Dept., Peoples First National Bank & Trust Co., Pittsburgh, Pa., using 3" deep L-I-N-O-L-I-T-E Series 12 with four 40W lamps, hinged glass bottoms (12-448HG), surface mounted.

Whether you wish to illuminate a bank, an office, a showroom or an entire building, a ***PLAN-O-LITE*** layout by Frink is the sure approach to *guaranteed* lighting satisfaction.

At no extra cost Frink will provide you with a complete ***PLAN-O-LITE*** fluorescent layout *engineered* to meet your exact illumination needs. Based on Frink's 90 years of experience, it will chart the *custom-designed* installation which can be achieved at *standard-fixture* cost. Most important, it will *guarantee complete satisfaction,* if Frink specifications are followed.

The coupon below will bring you an interesting sample packet of ***PLAN-O-LITE*** fluorescent layouts and the resulting installations. Mail it today.

CLIP THIS TO YOUR LETTERHEAD

THE FRINK CORPORATION
27-01 Bridge Plaza North, L. I. C., N. Y.

Without cost or obligation, send your sample packet of PLAN-O-LITE fluorescent layouts and photos to the

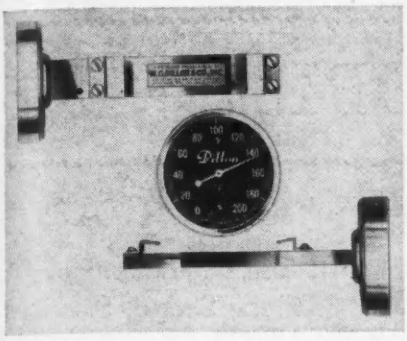
Attention of .....

( ) also please send catalogue of new Frink fluorescent fixtures. Dept. 2-EW

There's a Frink L-I-N-O-L-I-T-E fixture correctly engineered for every commercial fluorescent lighting need. Seventeen standard designs of highest quality workmanship and materials, each available with matching incandescent down-lights if desired. Check coupon at left for your copy of the Frink catalogue today.

PLANNED LIGHTING FRINK SINCE 1847

THE FRINK CORPORATION
27-01 BRIDGE PLAZA NORTH, LONG ISLAND CITY, N. Y.



St, Chicago 44, Ill. The over-all design is stated to present a wide heat-absorbing area.

Attachment can be by C-clamp, by drilling, tapping and screwing down, and by brackets for busbar as shown.

Flat stems can be supplied in a range of metals, in varying widths, thicknesses and lengths to meet requirements. Standard capacities are 0-200 F, 50-500 F, 150-750 F and 200-1000 F. Centigrade ranges are available on order.

•

Three-Phase Welders

A NEW SERIES of press-type welders has been announced by Sciaky Bros, 4915 West 67th St, Chicago 38, Ill. Utilizing a standard frame size, these welders offer a choice of five power ratings (20, 30, 40, 50, and 75 kva) and four throat depths (12, 18, 24 and 30 in.). Capacities on mild steel range from 0.016 in. up to 0.125 in.

If desired, the welders can be furnished with three-phase. This feature is said to reduce the required power rating by 50 percent. The machine operates on a balanced three-phase load at a power factor of 85 percent or better. Fully automatic electronic control of the welding sequence is included.

Optional features include a pre-heat and post-heat sequence which permits the welding of scaly and high carbon steel.

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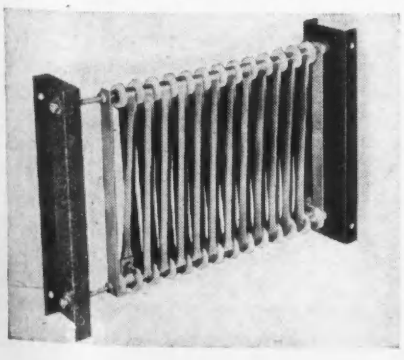
Ribbon Resistors

DEVELOPMENT OF LOOPOHM resistors has been announced by Ward Leonard



Electric Co, Mount Vernon, N. Y. The newly designed resistors are intended for continuous-duty, high-current applications where mechanical shock and vibration prevail. They are reported to be suited for use on crane hoists, welding equipment, portable load banks, controller assemblies and others.

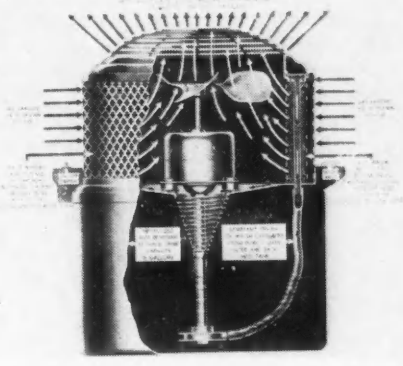
A Loopohm resistor consists of a channeled resistance alloy ribbon of uniform cross section formed in a series of loops supported between two rods insulated with ceramic bushings and washers. The rods are securely bolted to pressed steel frames. Each unit is equipped with two end terminals for connection purposes. They are adaptable to single or multi-unit mounting.

Standard Loopohm resistors are available with continuous current capacities from 20 to 110 amp and with a wide range of resistance values. Where required the resistors can be furnished with tapered current capacities, fixed or adjustable clamp taps, end frames and expanded or sheet metal enclosures.

•

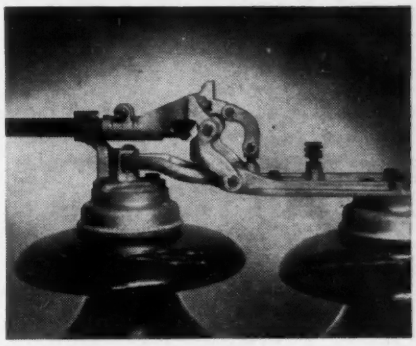
Humidifier

A "WATERFALL" ACTION to filter, wash, and moisturize the air is incorporated in the new model 600 humidifier, manufactured by Fresh'nd-Aire Co, 221 North La Salle St, Chicago 1, Ill.



In the unit a motor drives both a fan blade and a circulating pump. Water from the 3-gal reservoir in the base of the humidifier is pumped to the top of the unit where it is forced through a water distributing ring. The water streams out through holes in the distributing ring, falling through a fibrous filter, thereby creating what is in effect, a circular waterfall. (See illustration). Through this curtain of falling water, air is drawn by the motion of the fan and emerges clear and humidified from top of unit.

The unit disperses 13,000 cu ft of air per hr. The pump forces a stream of water down through the filter at the rate of 60 gal per hr.



Air-Break Switches

A NEW LINE of air-break switches known as Type A-W has been announced by Hi-Voltage Equipment Co, 4000 East 116th St, Cleveland 4, Ohio. The new model supersedes the type S-W line, and is intended primarily for line sectionalizing and substation work.

The A-W models are available in ratings from 7.5 to 46 kv and 400 to 1200 amp. Upright, underhung or vertical mounting is provided. Operating mechanism can be arranged for manual or motor operation.

By employing a direct mechanical linkage from the operating shaft to the switch arm, several advantages are achieved: (1) no lost motion, resulting in positive control of the switch arm; (2) increased leverage at critical points of the operating cycle; (3) operating effort supplied directly to the switch arm.

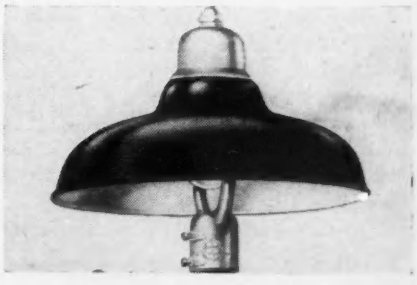
Movement of the switch arm is in a straight line into and out of the stainless steel, spring-backed contacts.

•

Island Light

A NEW ALL-PURPOSE island light which uses a base-up lamp is produced by Bright Light Reflector Co, Bridgeport 5, Conn. This Silv-A-King unit features a wiring trough with lamp holders which makes it adaptable to auxiliary lighting services such as are used for advertising displays, building illuminations, approach lighting or for supporting an integrated display piece.

This lamp is said to have complete weather protection for wiring and sockets. Porcelain enamel reflectors can be supplied in either red, green, cream or blue.



NEWS ABOUT PEOPLE

Roebling's Names Hartmann General Sales Manager

E. George Hartmann has been appointed general sales manager of John A. Roebling's Sons Co, Trenton, N. J.

E. G. HARTMANN

Mr Hartmann brings to his new position more than 29 years experience in the wire field and has been identified with the Roebling company since 1940.

Widely known in the industry, Mr Hartmann is member of the Wire Association and the American Iron and Steel Institute.

•

▶A. C. ABBOTT has been appointed assistant manager of the commercial and distribution department of the Shawinigan Water & Power Co, Montreal. Mr Abbott has served as chairman of several technical committees of the Canadian Electrical Association and at the present time is chairman of the engineering section.

▶DR JOHN T. BLAKE, director of research, Simplex Wire & Cable Co, Cambridge, Mass., has been honored recently by fellow scientists. He was listed as "one of the ten ablest chemists or chemical engineers working in rubber chemistry in this country." The poll was made among specialists in each field covered. Dr Blake was chairman of the rubber division of the American Chemical Society in 1943, holds several fellowships in this country and abroad, and served the armed forces of the United States in advisory technical capacities in wire and cable work during the late war. He joined the Simplex company in 1924.

▶V. A. AINSWORTH, manager since 1935 of the Maritime Electric Co in Charlottetown, Prince Edward Island, has been appointed general manager of that company, which has recently moved to Charlottetown from St. Stephen, Nova Scotia. Mr. Ainsworth succeeds T. J. COLEMAN, retired.

•

Barron Directs Combined Operations in New Jersey

Jacob Barron has been named vice-president in charge of combined operations of Public Service Corp of New Jersey, a position recently created by the board of directors. He had been vice-president in charge of electric operations since 1935 and for the past year was in charge of the operating committee. In his new capacity, he will be in charge of gas and transportation in addition to electric.

Lyle McDonald, formerly vice-president and controller, has been made vice-president in charge of finance. He assumed the duties of the office vacated by Percy S. Young, when he was named chairman of the executive committee several years ago. Mr Young's retirement as a director was announced last week. He had retired as an officer in December.

•

▶LEO F. CHAMBERS has been elected vice-president and treasurer of the Northern States Power Co of Minnesota. He was chosen to fill the vacancy caused by the recent advancement of Bernard F. Braheney to the position of president and general manager of the company. He entered the service of the company in 1912.

▶CHARLES S. HAMMOND, assistant to the commercial vice-president since 1926, has been appointed assistant to the president of Georgia Power Co. A graduate of Georgia Tech in 1913, Mr Hammond joined the Atlanta utility shortly after graduation.

Detroit Testing Laboratory Widens Scope, Services

With the goal of furnishing Detroit industries with a more advanced type of testing and development service, a new research group has been organized. Nucleus of the organization is the Detroit Testing Laboratory. Douglas Dow has been elected president and general manager, succeeding William P. Putnam, who is retiring.

DOUGLAS DOW

The new board reflects a change in ownership in the Detroit Testing Laboratory. Douglas Dow, formerly director of commercial research of Detroit Edison Co, assumes direct management, acting as trustee for a newly formed group of investors active in local business and industry.

Mr Dow brings a distinguished civic and engineering record to his new position. In the regime of several mayors, he has served as Detroit's Commissioner of Purchases and Supplies, president of the Board of Water Commissioners, and as trustee of the Wayne University Foundation. He spent 4 years with the General Electric Co following graduation from the University of Michigan in 1922 and subsequently became associated with the controller's staff of Detroit Edison Co, later entering the stores department. He was serving as chief of research when he entered military service, and upon his return to the utility, he was assigned to the sales department in charge of commercial research.

Mr Dow was vice-president of the old

Reduce Cableway Costs

WITH TRANSITE DUCTS

YOU GET EVERY ADVANTAGE necessary for lowest cost distribution systems when you use Transite Conduit and Korduct. The greater strength of Transite—made of asbestos and cement—protects cables from traffic pressure and vibration. Tight joints shut out seepage—reduce possibility of water damage to sheath.

Transite Ducts are incombustible—this confines burnouts, protects adjacent cables from fire. Transite Ducts give lasting service because they are inorganic and non-metallic . . . immune to rust, rot, corrosion and electrolysis.

When streets must be opened, however, for cable installation or direction changes, the job can be done faster with Transite Ducts for several reasons. Long, lightweight lengths—a complete line of fittings—simple coupling method—all combine to make faster assembly. Smooth bore makes long cable pulls easier.

For further information explaining how Transite Ducts reduce cableway costs, write for Data Book DS 410, Johns-Manville, Box 290, New York 16, N. Y.

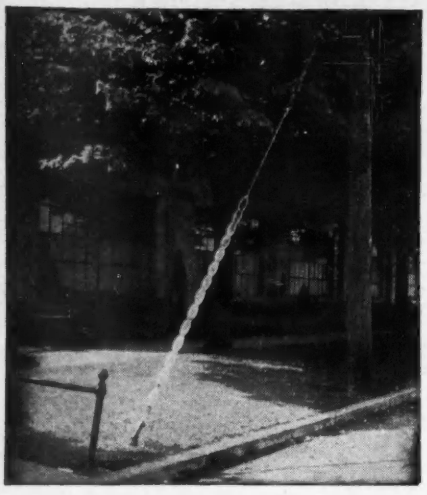
JOHNS-MANVILLE JM PRODUCTS

Johns-Manville

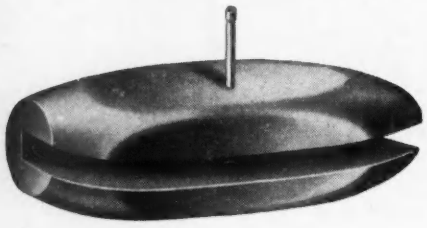
TRANSITE DUCTS

CONDUIT for use without concrete

KORDUCT for concreting in



THE NEW GUARD THAT HAS BECOME SO POPULAR



Flexibal

The GUARD that gives with the GUY

Literally a string of pillows, the Overton-Flexibal Guy Guard cushions the shock. It is the only guard that *gives* with the guy. No other type is so easy to handle, so simple to install. None other is so effective in cutting down losses. Nothing ever puts it out of commission. And they cost less! Separate spindles, smoothly shaped, are made of hard wood and aluminum-painted for greatest visibility and long life. Adjustable to any length in 6-inch steps. 5-6-7-8 foot lengths boxed for immediate shipment, — no waiting. Modernize your guy wire guards now, — you'll never go back to the old rigid style once you try Overton-Flexibal. Field-tested for years in thousands of locations.

AVAILABLE NOW, AND AT ALL TIMES

PACKAGED FOR EASY HANDLING AND STORAGE

Send for Free Sample

Flexibal GUY GUARD
Is produced solely by
S.E. OVERTON CO.
SOUTH HAVEN, MICHIGAN

Detroit Engineering Society, was one of the charter members of the new Engineering Society of Detroit, and at the present time is assistant secretary and treasurer of the Rackham Engineering Foundation.

•

Westinghouse International Makes New Appointments

Several new appointments have been announced recently by the Westinghouse Electric International Co.

Herman J. Mauderer has been elected vice-president and auditor; Arthur L. Partridge has been appointed assistant to the president; J. D. Mickle, manager of the import department; and William W. Crittenden, manager of the special projects department.

Mr Mauderer, who will have charge of all service functions, such as accounting traffic and warehousing, has been connected with the company since 1921. For many years connected with banking and import circles, Mr Partridge joined the company in 1941. In his new executive capacity he will coordinate the entire import program with other company activities. Mr Mickle became identified with the company in 1928, was made manager of the Russian department in 1945 and assistant apparatus manager in 1946. As manager of the special projects department, Mr Crittenden succeeds J. R. Bejarano, who has resigned to join a Brazilian company. Mr Crittenden became associated with Westinghouse International 22 years ago and was made assistant manager of the special projects department last year.

•

▶ Samuel I. Nichols has been appointed to head the public utility section of the Louisiana Public Service Commission. The utilities section is now recomputing the investments of utilities as bases for rates. Mr Nichols succeeds Langston Ashford, who resigned as chief engineer of the commission to go to Arkansas. Mr Nichols also becomes chief accountant for the commission.

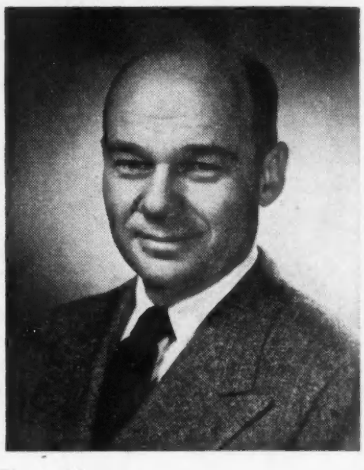
▶ Prof Edmund W. Sinnott, dean of the Sheffield Scientific School, and director of the Yale University Division of Sciences, assumed office as president of the American Association for the Advancement of Science on Jan 15.

▶ Hubert L. Brown has been appointed assistant chief operating engineer of the Kansas City Power & Light Co, Kansas City, Mo. Mr Brown joined the company in 1936.

E. A. Nickel Joins Kahn Mfg Co As Sales Manager

Kahn Manufacturing Co, Inc, Milwaukee, has announced the appointment of Edwin A. Nickel as general sales manager. For the past 7 years Mr Nickel has been active in the lighting industry as sales manager of the Mitchell Manufacturing Co, Chicago.

He brings to the Kahn organization a background of more thn 20 years experience as sales, merchandising and



E. A. Nickel

marketing executive, chiefly in the lighting and electrical fields, having served previously with Sylvania Electric Products Inc, Dictograph Products Co and with Lennen & Mitchell, a New York advertising agency. He will maintain an office at the factory in Milwaukee, as well as in Chicago.

•

▶ Dr Wallace R. Brode, well known chemist, has been appointed associate director of the National Bureau of Standards. He succeeds Dr Hugh L. Dryden, who was recently appointed director of aeronautical research of the National Advisory Committee for Aeronautics. Dr Brode has done outstanding work in spectroscopy. He goes to the Bureau from Ohio State University, where he has been professor of chemistry. At the Bureau of Standards he will act as liaison between the Bureau and the Department of National Defense. He was a member of the London Mission of the Office of Scientific Research and Development in 1944-45. Dr Brode is a member of the American Chemical Society, American Society for Testing Materials and the Optical Society of America.

▶ Samuel W. Dudley, dean of the Yale School of Engineering and director of the University Division of Engineering, will retire from the faculty on July 1. He will be succeeded by Walter J.

WOHLENBERG, Sterling Professor of Mechanical Engineering. Prof Dudley has been on the Yale faculty since 1921, and dean of the school of engineering since 1936.

▶ PHILIP W. LOTZ, vice-president of the Joslyn Mfg & Supply Co, Chicago, since 1936, has been elected executive vice-president of the company.

▶ G. R. F. TROOP has been appointed vice-president and treasurer of the Brazilian Traction, Light & Power Co. ARNOLD GAINE has been named vice-president (administration) and OSBORNE MITCHELL secretary.

▶ ANTHONY J. YUSK has recently taken over the responsibilities of the switchgear sales for the Electric Power Equipment Corp, Philadelphia, Pa. He has been serving for some time as assistant sales manager. Mr Yusk spent considerable time as a switchgear design engineer with the Westinghouse Electric Corp and was also connected with the engineering department of I.T.E. Circuit Breaker Co. His mechanical engineering experience was developed while acting as engineer for the H. A. Lingard Associates, consulting engineers of Camden, N. J.

▶ A. DEAN DUDLEY, vice-president of the Central New York Power Corp, Syracuse, has retired. Mr Dudley has rounded out 50 years of continuous service. As director of the company's commercial activities, Mr Dudley was one of the pioneers in the development of the electric utility industry in Syracuse. In 1917, he was elected treasurer and assistant secretary of the Syracuse Lighting Co, Inc; a vice-president in 1930; and later that year, president. Following the merger of several companies, Mr Dudley was elected a vice-president and director of Central New York Power Corp.

▶ STEPHEN J. FLANAGAN, for the past two years field engineer for the Copper Wire Engineering Association in the states of Michigan, Indiana, Ohio, Kentucky and Tennessee, has resigned. He has been appointed district sales manager for the Brown Wood Preserving Co of Louisville, Ky. JOHN P. HEWITT of Bowling Green, Ky., has been appointed to succeed Mr Flanagan. Mr Flanagan was employed by the association as headquarters' engineer for two years before the war. During the war he served in both the Pacific and European theaters. Mr Hewitt has been actively engaged as an engineer in connection with the rural electrification program for the past 10 years. For the past 7 years he has been connected with the Rural

Investigate...

THE FISHER-PIERCE PHOTOELECTRIC CONTROL FOR MULTIPLE STREET LIGHTS

NEW LIGHT ON THE PROBLEM OF STREET LIGHTING

The Fisher-Pierce Company — specialists in electronic applications — offer a new control — a simplified Automatic Photoelectric Unit for Multiple Street Light Control.

The interest already shown by hundreds of utilities in such a development centers around these features:—

1. **Flexibility** — individual street lights can be connected directly to 120-volt distribution lines.
2. **Lower Costs** in service and maintenance compared with other methods of control.
3. **Quality** of lighting service secured.

With FISHER-PIERCE PHOTOELECTRIC CONTROL it is possible to preset the value of illumination at which it is desired to turn on the lights— lights so controlled will go on at that value of illumination day after day regardless of specific location, weather conditions, or obstacles.

Technical Characteristics & Features — This control operates dependably down to less than 1 foot-candle. It has a built-in differential and time delay to avoid operation by lightning, clouds or cycling—absolute minimum of components. Contact rating 500 watts — up to 3000 watts with auxiliary contactor.

Maintenance Procedure — Routine maintenance necessary only once per year — in addition to its technical advantages, plug-in replacement eliminates the need for service on the pole and permits full utilization of skilled technician's time.

Installation — Heavy galvanized mounting bracket fastens directly to distribution pole.

This control may also be used for Outdoor Advertising—Yard Lighting—Radio Towers—Airport Beacons and Lights—Warning Signals—Underpasses—Merchants Signs—Indoor Light Control.

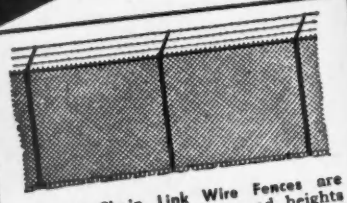
Write for Bulletin FP61300 for further information.

Units can be shipped from stock.

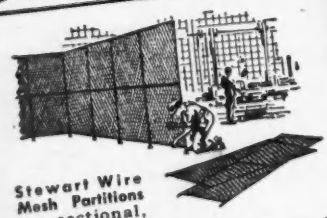
FISHER-PIERCE COMPANY
82 CEYLON ST., BOSTON 21, MASS.

STEWART FENCES AND METAL SPECIALTIES

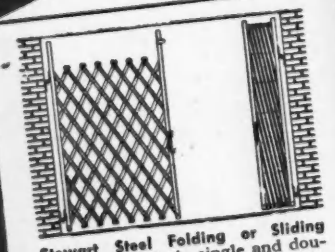
Stewart Wire and Iron Products include many items which are used extensively in the electrical field. Three are illustrated. Others are Iron Picket Fences and Gates; Wire and Iron Window Guards; Machinery Guards; Pipe Railings; All Steel Settees, etc.



Stewart Chain Link Wire Fences are made in several weights and heights to meet all requirements. Style 3TH is shown above. Also made in style 5TH (5 strands of barbed wire) and 0TH, without barbed wire overhang.



Stewart Wire Mesh Partitions are sectional, and made to fit any space. Give all measurements when writing for information.



Stewart Steel Folding or Sliding Gates are made in single and double construction to fit any opening.

Literature sent on request. When writing please mention products in which you are especially interested.

The Stewart Iron Works Co., Inc.
1566 Stewart Block Cincinnati 1, Ohio
Experts in Metal Fabrications Since 1886

Stewart IRON and WIRE FENCES

Electrification Administration as field construction engineer. During the war Mr Hewitt was engaged in construction of the Alaska-Canada Telephone Line with the U. S. Army Signal Corp.

OBITUARY

CLIFFORD B. LEPAGE, assistant secretary of the American Society of Mechanical Engineers for 30 years, died suddenly on Jan 15 in Hartford, Conn., where he had gone to attend a meeting of the American Standards Association. A native New Yorker, Mr LePage obtained the degree of master of engineering from Stevens Institute of Technology in Hoboken, N. J., in 1902. He worked as a draftsman in Westchester and Nassau Counties, New York, and had been an engineer and designer for the United Telpherage Co of New York. From 1903 to 1921 he was instructor and then assistant professor of physics at Stevens. He was appointed assistant secretary of ASME in 1918 and was secretary of its standing committees on research, standardization, power test codes and safety. Mr LePage was assistant director of the Secretariat for Prime Mover of the International Electrotechnical Commission and was a member of many scientific organizations.

▶ HOWARD W. DEXTER, JR, an electrical engineer with the Duquesne Light Co, Pittsburgh, for 21 years, died on Jan 18 at the age of 46. Born in Valdosta, Ga., Mr Dexter was graduated from Massachusetts Institute of Technology in 1923 with degrees in electrical and mechanical engineering. He was identified with West Penn Power Co before joining Duquesne Light. He was a member of the American Institute of Electrical Engineers, Electrical Engineers Society of Western Pennsylvania and the Electric League of Pennsylvania.

▶ EUGENE B. FRASER, 78, for the past 47 years treasurer of the Lynn (Mass.) Gas & Electric Co, died in that city Jan 15. He was born in Lynn and was engaged in banking in early life. Mr Fraser had been a member of the Executive Council to the governor of Massachusetts for 16 years. He was also a director of the Campbell Electric Co, Lynn.

▶ FRANK N. WATERMAN, New York patent consultant, who had represented many electric and radio corporations in patent litigations before he retired in 1939, died on Jan 19 at his home in Summit, N. J. Mr Waterman handled many early patent cases for Westinghouse, General Electric and other electric companies, and also many of the early radio patent cases. He was consultant to the Radio Corp of America. Mr Waterman was born in Toledo, Ohio, 82 years ago. He went to work for the Westinghouse Electric Corp developing electric street railway systems, but after a few years left to set up an office as engineering consultant. Gradually he began to specialize in electric and mechanical patent matters. He was the author of many papers on subjects in his field. Mr Waterman was a member of the American Institute of Electrical Engineers, the Institute of Radio Engineers and the American Physical Society.

▶ CHARLES W. STANBROUGH, formerly advertising manager of the Kansas City (Mo.) Power & Light Co, died on Dec 23 of a heart attack at his home in Oak Park, Ill. He was 52 years old. Mr Stanbrough was connected with the Kansas City utility for about 20 years before he moved to Chicago 9 years ago. At that time he severed his utility connection to become Chicago district distributor for Luzier's Inc, cosmetics and perfume manufacturers.

▶ RODNEY D. HALL, assistant to the vice-president of the public works division of the Worthington Pump & Machinery Corp, Harrison, N. J., died on Jan 13 in Hartford, Conn. He was 71 years old. Mr. Hall, a native of Buffalo, fifty-one years ago joined the Snow Steam Pump Co of Buffalo, which later was incorporated with the Worthington company. He was a member of the American Society of Mechanical Engineers and the American Water Works Association.

▶ JOHN P. TOMPKINS, retired assistant general manager of the Atlantic City (N.J.) Electric Co, died on Jan 7 at his home in that city. He was 84 years old. Mr. Tompkins started with the old Atlantic City Gas & Water Co in 1884 and worked up to general manager. He became assistant general manager when that company merged with the Atlantic City Electric Co in 1908, a position he held until his retirement in 1928.

▶ LEON S. DURE, JR, financier and head of Dure & Beeks, Macon, Ga., died on Jan 10 at the age of 73. Mr Dure had also held executive positions with the old Macon Railway & Light Co and the old Central Georgia Power Co.

▶ ROBERT SCHOONMAKER, founder and president of the Diesel Motors Corp., Port Washington, L. I., New York, died at his home in that city on Jan 6 as the result of a cerebral hemorrhage. Mr

Schoonmaker was a native of South Jacksonville, Fla. He formerly was associated with his father, Alfred G. Schoonmaker, in a machinery business in New York City, and for a number of years worked as an engineer in the automotive division of the American Locomotive Co at Providence, R. I., before founding his diesel motors company.

▶ JOHN L. VAIDEN, who had been connected with the Consolidated Edison Co in New York for 24 years, died at his home in Westfield, N. J., of a heart attack. He was 54 years old. During World War II, Mr Vaiden had a distinguished Navy career. For the Consolidated Edison Co, Mr Vaiden had been distribution engineer in the electrical engineering department during the past 3 years. He joined the organization in 1922 as an engineer's assistant.

▶ RONALD M. EASLEY, 60, power sales engineer at Malden, Mass., for the Mystic Valley district, New England Electric System, died suddenly at Salem, Mass., on Jan 11. In his earlier career he was employed by the Consolidated Edison Co, Inc, New York. Joining the New England system in 1928 he became sales manager of the Salem and Revere companies north of Boston. He was transferred to Malden in 1946.

▶ JOHN G. WEBB, inventor of the Webb electric steel furnace and rolling mill superintendent for the Old Dominion Iron & Steel Corp, Richmond, Va., died on Jan 1 in that city. He was 63 years old. Mr Webb was connected with the General Electric Co for 6 years before going to the Old Dominion more than 25 years ago. He was a native of Charleston, S. C.

▶ J. L. WEATHERS of Fayetteville, N. C., died on Dec 24 in Charlotte, N. C., at the age of 64. Mr Weathers was born in Shelby, N. C. He first was connected with the Shelby municipal light and power plant, later moving to Lumberton where he became identified with the local municipal plant. In 1918 he moved to Fayetteville, where he was associated with the Public Works Commission first as superintendent and later as manager.

▶ EDWARD L. WOOD, 35, design engineer for the American Electric Furnace Co, Dorchester, Mass., died at Boston on Jan 9.

▶ WILLIAM E. REID, a research engineer for the Bell Telephone Laboratories, New York, died of a heart attack at his home in Hastings-On-Hudson, N. Y., on Jan. 23. He was 55 years old.

ELECTRIC POWER ECONOMIES

PALMER LIMITERS

• More and more utilities are turning to the PALMER LIMITER METHOD of controlling electric range and water heater loads. The use of PALMER LIMITERS improves the domestic load factor without increasing the power supply investment.

You cannot afford to neglect this opportunity for extra load dividends. Investigate the PALMER LIMITER.

Listed by Underwriters' Laboratories.

WRITE FOR BULLETIN A-1

PALMER AnA SWITCH

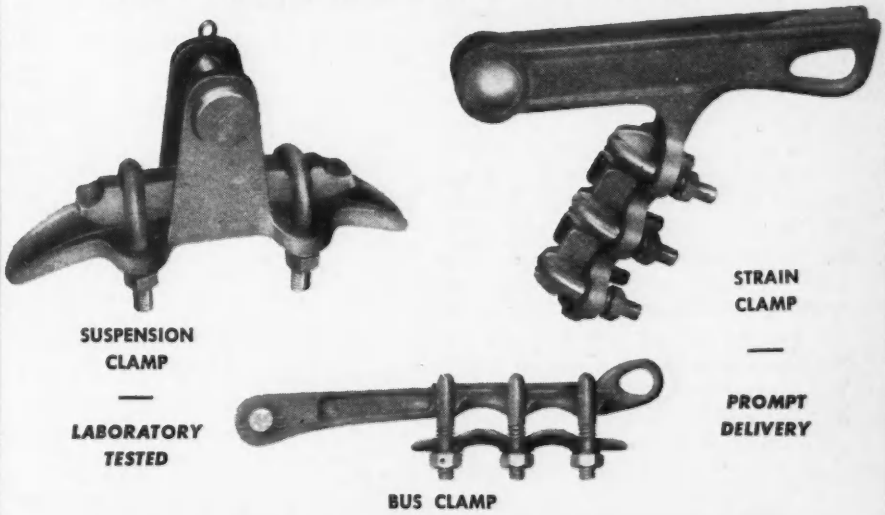
PALMER ELECTRIC & MFG. CO. 24 Water St., Wakefield, Mass.

HOW MUCH POWER ARE YOU LOSING?

BRONZE AND ALUMINUM

SUSPENSION AND STRAIN CLAMPS

STOP MAGNETIC HEATING & ELECTROLYSIS



SUSPENSION CLAMP — LABORATORY TESTED

STRAIN CLAMP — PROMPT DELIVERY

BUS CLAMP

Modern research reveals that ferrous clamps can cause as much as 200 watts loss each. How many do you have on your system? All sizes available.

Please write for Literature

Electric Fittings Foundry - Birmingham, Ala.

MANUFACTURERS & MARKETS

Air Reduction Forms New West Coast Subsidiary

The Air Reduction Co has formed a new wholly-owned subsidiary, the Air Reduction Pacific Co, C. S. Munson, president, has announced. The new subsidiary will carry on all the business formerly conducted by Air Reduction Sales Co in the western region of the United States, including the present San Francisco, Los Angeles, Portland and Seattle sales districts. These districts, which embrace all or parts of 8 western states, will retain their identity within the new company.

H. P. Etter, formerly sales manager of the Pacific Coast division, has been named president and director of Air Reduction Pacific Co with headquarters in San Francisco.

Other directors will be Messrs. C. Gibson, G. E. Hawkins, J. A. Hill, C. G. Andrew and W. C. Keeley, who will also serve as chairman of the board.

•

Gregory Electric Purchases Bomb Plant in San Diego

Immediately after the purchase of the Consolidated Vultee Aircraft Corp. No. 2 plant at San Diego from WAA by C. W. Carlstrom, San Diego, announcement was made that the drop hammer building of the former bomber plant had been sold to Gregory Electric Co, Chicago manufacturer of electric transformers.

The drop hammer building is a three-story structure, 80 x 250 ft. It will be used as a branch factory after $300,000 in improvements and equipment installations have been made, Joseph Pass, president of the Chicago company, said. The branch, in addition to the present line of transformers, will make a small unit for use on farms. The company plans to centralize production and distribution for western states and Oriental export at San Diego.

•

Will Equip New Pipe Line

Westinghouse Electric Corp has announced receipt of a contract to furnish all electrical equipment for a new crude oil pipe line in which the Shell Pipe Line Corp and Texas Pipe Line Co will own undivided interests. The line will originate at Cushing, Okla., and have terminals at Wood River and Salem, Ill. More than 35,000 hp in electric motors will be required to power the eight pumping stations.

DAY-BRITE LIGHTING, INC, has formally opened its new plant at Tupelo, Miss. The new plant has 51,000 sq ft of floor space and was engineered specifically for the straight-line production of standard lighting fixtures. Taking part in the ceremonies were J. P. Nanney, left, mayor of Tupelo; D. J. Biller, president of Day-Brite; and W. E. Barksdale, director of the Mississippi Agriculture and Industrial Board

•

Pattern Makers Select Own Westinghouse Union

A group of pattern makers in the Cleveland plant of the Westinghouse Electric Corp has become the first craft unit to receive separate bargaining rights under the Taft-Hartley Act.

In an election conducted by the National Labor Relations Board, the group voted 18 to 0 to be represented by the Pattern Makers League of North America, AFL. The pattern makers had previously bargained on a plant-wide basis through the United Electrical, Radio & Machine Workers, CIO.

•

Moves to Larger Quarters

United Electric Controls Co have transferred their offices and production facilities from 79 A St, South Boston, to new and larger quarters at 85 School St, Watertown 72, Mass. The new building affords approximately double the floor space of the old.

New Division Will Handle Ingersoll Utility Unit

Expansion of Borg-Warner Corp's divisional structure to intensify manufacturing and selling of the Ingersoll Utility Unit is now under way. Organization of a new division is being handled by Roy C. Ingersoll, vice-president of Borg-Warner and president of Ingersoll steel division. He will be president of the new Ingersoll Utility Unit division which will constitute the seventh Ingersoll managed division in the Borg-Warner group.

Direct management of the new unit will be in the hands of Robert S. Ingersoll, a vice-president of Ingersoll Steel. All the key personnel in the handling of the Utility Unit and other consumer products will be transferred to the new division.

•

Jobbers Supply Co Will Operate as Joslyn Unit

The Jobbers Supply Co, St. Paul, Minn., will operate as a division of the Joslyn Mfg & Supply Co, Chicago, using the name Joslyn Mfg & Supply Co and will continue the office and warehouse in St. Paul.

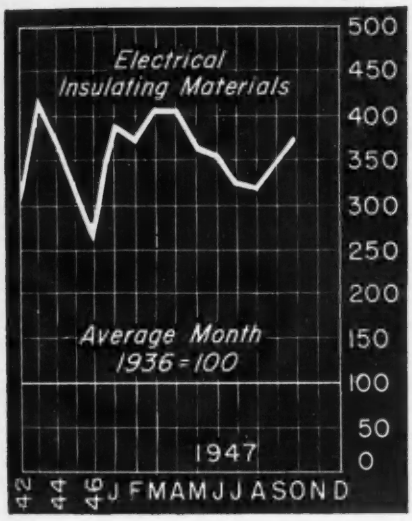
Announcement was also made that the Jobbers Supply Co of Seattle,

Wash., and Portland, Ore., will operate as a division of the Joslyn Pacific Co. Offices and warehouses will be maintained as in the past, but the company will be under the name of Joslyn Pacific Co (formerly the Joslyn Co of California).

•

Insulating Material Sales Advance in October

Sales billed on electrical insulating materials during the month of October 1947 moved upward from those recorded in September, according to the



index compiled by the National Electrical Manufacturers Association. The index advanced to 381 from 350, an increase of 9 percent.

In October 1946 the index stood at 351, this year's figure representing an increase of 9 percent, according to the NEMA index.

•

Manufacturers Make Sales Assignments

Electrical manufacturing companies have recently made the following appointments to their sales staffs:

A. B. CHANCE Co, Centralia, Mo., in an expansion of its engineering sales service, has appointed 3 new sales engineers—William A. Nelson, Wilmer L. Dague, and Frank G. Haley. Nelson will represent the company in Iowa and Nebraska, with headquarters in Des Moines; Dague in Oklahoma and western Kansas with offices at 1647 North Hillside, Wichita; and Haley will travel out of New Orleans.

GENERAL DETROIT CORP has appointed 3 new zone sales managers—Charles W. Self, Paul R. Warren, and John Macksey. Self will be in charge of the Cincinnati zone office at 307 E. Fourth St; Warren of the Boston zone office at 258 Park Square Bldg; and Macksey of the St. Louis zone office at 318 Title Guaranty Bldg.

TRANSFORMER TOPICS BY KUHLMAN—No. 1

The series of transformer problem questions and answers, included in Kuhlman Electric Co. advertisements of recent months, has proved so popular that it is presented here as a feature separate from our advertisement on the back cover of this magazine. We hope that our many friends, both old and new, will continue to find Transformer Topics informative and will send us their transformer problems for assistance.

Question: Two single phase transformers T_1 (50 KVA) and T_2 (25 KVA) are to be connected in parallel to supply a total load of 75 KVA. (Figure 1).

The primary and secondary voltages of both transformers are 7200 and 240 volts. T_2 has 3 - 4½% taps below 7200 volts. Assume the transformers have the same impedance, 3.5%.

What circulating current will flow if, through an oversight, the tap changer of T_2 has been left on the 86½% tap?

Answer: The % Impedance (Z_1) of T_1 in percent of total load is 75/50 (3.5)=5.25%

The % Impedance (Z_2) of T_2 in percent of total load is 75/25 (3.5)=10.5%

The circulating current in percent of total load, considering impedances in terms of total load, is:

$$I_C = \frac{\frac{(N_1 - N_2) \times 100}{N_1}}{Z_1 + Z_2} I_L = \frac{\frac{(1 - .865)}{1}(100)\, I_L}{15.75} = \frac{13.5\, I_L}{15.75}$$

$= .857\, I_L$ = 85.7% of the 75 KVA current.

The windings of the 25 KVA transformer are designed for 25/75 = 33-1/3% of the 75 KVA current and the 50 KVA transformer is designed for 50/75= 66-2/3% of the 75 KVA current.

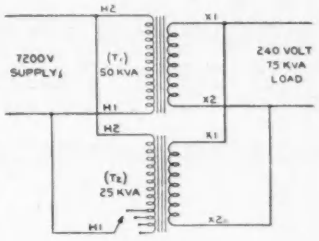


FIGURE 1

Thus this mismatch of turns ratio has caused a circulating current of 85.7/33.3 or 2.58 times the rated current of the 25 KVA transformer and 85.7/66.6 or 1.29 times the rated current of the 50 KVA transformer.

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Plus or Minus 10% Made Allis-Chalmers Standard

Standardization on plus or minus 10 percent load ratio control, the maximum range of regulation required by the majority of unit substation applications, in all types of single and multi-circuit unit substations, has been announced by Allis-Chalmers Manufacturing Co.

The company's decision is based on the fact that over one-half of its orders specify plus or minus 10 percent load ratio control and that the new unit substations, which will be built in thirty-two 5/8 percent steps, will hold voltage to plus or minus 1 v.

Company engineers point out that the load ratio control transformer section of a unit substation is effectively equivalent to a transformer plus a feeder voltage regulator.

•

Phelps Dodge Discovers New Copper Ore Body

A new copper ore body has been discovered on the Phelps Dodge Corp property near Jerome, Ariz.

The find is the result of exploration work by the mining company at levels lower than previously mined. Advances in the price of copper and the removal of controls made this low-level mining possible.

The rich new deposit is nearly a mile below the surface and will permit continuation of Phelps Dodge operations in the area for about a year. The company had previously announced that Jerome would soon become a ghost town because known ore deposits were rapidly being spent.

•

Approves Plug-In Heater

Consolidated Edison Co of New York, Inc, has announced that a fan-type plug-in electric heater named the "Surf Season-Air," manufactured by G-M Laboratories, Inc, has been approved for participation in the current activity of the company and its cooperating appliance dealers.

The addition brings to 18 the number of plug-in type electric-heater models approved for participation.

•

Hall Doubles Capitalization

Stockholders of the C. M. Hall Lamp Co have voted to increase the authorized capitalization from $1,000,000 to $2,000,000 by increasing the number of $5 par common shares authorized to 400,000 from 200,000.

NEW ELECTRICAL CONSTRUCTION

A weekly selection of U. S. electrical construction projects announced by private and government utility systems involving more than $70,000. Also listed are major industrial and construction jobs where electrical work is indicated or implied

UTILITIES

Proposed Construction

California—Bureau Reclamation, Dpt. Interior, Bldg, 1-A, Denver Federal Center, Denver, Colo., coupling capacitor potential devices and carrier-current line traps for Shasta and Keswick Power Plants, Elverta Substation, and Tracy Switchyard, Central Valley Proj., Spec. 2032.

Colo., Trinidad—City, municipal power and light plant. **1,000,000** bonds voted.

Ind., Fort Wayne—Bd. P. Wks., Walter Vetter, chn., City Hall, surveys, etc., imprv. municipal power plant. **$500,000.** Emery, Marker & Emery, 510 Toledo Trust Bldg., Toledo, O., consult. engrs.

Minn., Lyle—Dairyland Power Co-operative, 407 Rivoli Bld., La Crosse, Wis., furnishing, installing two 2,500 kw diesel engines etc, in power bldg, to be constructed near here. Total est. over $500,000. Ellerbe & Co, E. 505 First Natl. Bank Bldg, St. Paul, engrs.

Missouri—Three Rivers Electric Co-operative, Linn, addnl. rural distr. lines and sys. imprvs., Osage Co. **$597,000.**

Nebraska—Custer Public Power Dist., Broken Bow, rural distr. lines in Custer and Sherman Counties. **$770,000.** Raymond H. Reed & Co, Columbus, consult. engrs.

N. M., Corona—Central New Mexico Electric Co-operative, Corona, building and power plant. $70,000. Beavers & Lodal, 1411 Transit Tower, San Antonio, Tex., engrs.

N. Y., St. George—Comrs. Marine & Aviation, Pier A, foot of Battery Pl, North River, temporary electrical facilities, etc, reconstruction of terminal and approaches at St. George Ferry Terminal, Constr. 2581. Plans deposit $5.

N. D., Grand Forks—Minnkota Power Co-operative, Grand Forks, transmission lines and turbine generators and condensers, Grand Forks Co. $2,500,000. Andrew L. Freeman, c/o owner, engr. Ellerbe & Co, 1st Natl. Bank Bldg, St. Paul, Minn., consult. engrs.

Oklahoma—Central Rural Electric Co-operative, Stillwater, 307 mi. rural distr. lines, completing previously approved construction and for completed construction with prior REA approval, Lincoln Co. **$508,000.**

South Dakota—LaCreek Electric Assoc, Inc, Martin, generating facilities, 266 mi. rural distr. lines, incl. acquisition 6 mi. existing line, Bennett Co. **$585,000.**

South Dakota — Bureau Reclamation, Dpt. Interior, Building 1-A, Denver Federal Center. Denver, Colo., furnishing, del. f.o.b. cars shipping point or f.o.b. cars Oral, 5 motor-operated, radial-gate hoists complete with electrical self-synchronous gate position indicating sys. incl. both transmitter and receiver for Angostura Dam. Angostura Unit, Missouri Basin Proj., Spec. 2092.

Tenn., Chattanooga—Tennessee Valley Auth., New Sprangle Bldg, Knoxville, primary substation. **$1,500,000.**

Virginia—Shenandoah Valley Electric Co-operative, Dayton, sys. imprvs., headquarters facilities, completion previously approved construction, completed construction with prior REA approval and 212 mi. rural distr. lines, Rockingham Co. **$675,000.**

Low Bidders & Contracts Awarded

Calif., San Jose—General Electric Co., 230 Montgomery St., San Francisco, 200 x 600 ft., steel motor plant factory, and attached 2 story, rein.-con. office bldg, to Parker, Steffens—Pearce. 135 S. Park St, San Francisco. Est over **$1,000,000.** LS. Rosener, 233 Sansome St, San Francisco, engr.

Florida — Clay Electric Co-operatives, Inc, Keystone Heights, completion project underway and further expansion to rural electric co-operative sys. in Clay, Alachua, Marion, Putnam, Union, Bradford, Duval, Baker, Volusia, and Levy Counties. Owner builds. **$1,250,000.**

Minn., Minneapolis and St. Paul—KSTP Radio Station, S. Hubbard, mgr., Radio City Bldg, 36 S. 9 St, Minneapolis, general contract 2 and 4 story, bsmnt., 82x136 ft., rein.-con., stone radio station with 568 ft. tower, University Ave. and Emerald St, to Kraus-Anderson, Inc, 501 S. 8 St, Minneapolis. **$282,785.** Bids 12/29.

Tex., Houston — Houston Lighting & Power Co, 1016 Walker St, 8 mi. White Way lighting sys. for Harrisburg and Holcombe Blvds. and Fannin St, incl. 528 steel standards, own forces. **$85,000.**

INDUSTRIAL, COMMERCIAL & PUBLIC BUILDINGS

Proposed Construction

Colo., Denver—Coca Cola Bottling Co, 1024 Cherokee St, 80,000 sq. ft. ultra-modern bottling plant. $1,000,000. Stone & Pitts, 1872 Calder St, Beaumont, Tex., engrs and archts.

D. C., Wash.—Georgetown University, 37 and O Sts. N.W.—gymnasium. **$800,000.**

Ga., Atlanta—Georgia Baptist Hospital, 450 East Ave. N.E., plans by Stevens & Wilkinson, 157 Luckie St, N.W., hospital addn. **$2,500,000.**

Ia., Grinnell—Grinnell College, Grinnell, science bldg. **$500,000.**

Ky., Newport—Campbell Co, Newport, hospital. **$1,900,000.**

La., Baton Rouge—Gulf Refining Co, Gulf Bldg, Houston, Tex., gas conservation plant, returning earth gas produced incidentally to oil fields production. **$4,000,000.**

N. J., Newark—Bd. Educ., 431 Green St, Dayton Street School. $1,000,000. E. Fred Cook, 45 Clinton St, archt.

N. Y., New York—Herbert J. Freezer, 200 Fifth Ave, Zone 10, plans by John Sloan Assoc., 420 Lexington Ave, Zone 17 and Edward D. Stone Assoc., 50 E. 64 St, Zone 21, 13 story office, theater and restaurant bldg, 7 Ave, Broadway, 51 and 52 Sts. **$6,000,000.**

Pa., Pittsburgh—University of Pittsburgh, Medical Center, School of Nursing and Nursing Home, plans by Ingham, Boyd & Pratt, 407 Liberty Ave, nurses home and training school, Lathrop St. **$2,500,000.**

S. C., Columbia—State, c/o Governor Strom Thurmond, State Capitol, penitentiary. **$5,000,000.**

Low Bidders & Contracts Awarded

Ga., Macon — Sears, Roebuck & Co, Ponce de Leon Ave, Atlanta, retail store, to Artley Constr. Co, 504 E. Bay St, Savannah. Est. about **$1,000,000.**

Ia., Des Moines—Northwestern Bell Telephone Co, 604 9 St, telephone bldg. addn., to A. H. Newmann & Bros, Inc, Hubbell Bldg. **$1,150,000.**

Kan., Sun City and Medicine Lodge—National Gypsum Co, 325 Delaware St, Buffalo, N. Y., general contract 2 mfg. plants, to Baltimore Constr. Co, 711 S. Central Ave, Baltimore. **$1,150,000.**

La., Angola—State Dpt. Finance, 201 Capitol Annex, Baton Rouge, Jan. 16, receiving station and hospital bldg, at Louisiana State Penitentiary, from J. A. Harper, Crewville. **$1,425,000** base bid.

Minn., Willmar — Northwestern Bell Telephone Co, 224 S. 5 St, Minneapolis, general contract 2 story, bsmnt., 72x92 ft, rein.-con., brick, telephone exchange, to Nelson Bros., Constr. Co, Willimar. Approx. **$900,000,** incl. equip. Magney, Tusler & Setter, 202 Foshay Tower, Minneapolis, archts.

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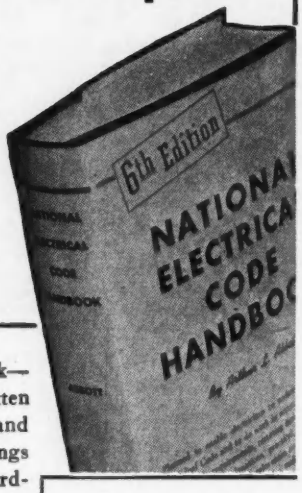

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